Aalto-yliopisto
Kauppakorkeakoulu

ECB crisis response - a view from the engine room

Kansantaloustiede

Maisterin tutkinnon tutkielma

Minna Kuusisto

2014

Taloustieteen laitos
Aalto-yliopisto
Kauppakorkeakoulu

Aalto University
School of Business

ECB crisis response – a view from the engine room

An overview on unconventional measures and an event study on announcement effects of 3-year-LTROs and the OMT

Master's thesis
Minna Kuusisto
28.2.2014
Economics

Approved by the Head of the Economics Department xx.xx.20xx and awarded the grade

_____

1. examiner 2.examiner

Abstract – Master's Thesis

Aalto University School of Business

Minna Kuusisto 28.2.2014

ECB crisis response – a view from the engine room

Objectives of the study

The objective of the study is to discuss the policy options of a central bank in a financial crisis from the viewpoint of monetary policy implementation. The aim is to recognize the scenarios in which a central bank ought to resort to unconventional monetary policy measures. Furthermore, the study pursues to provide a general overview and assessment of the effectiveness of the European Central Bank's (ECB) crisis response during the financial crisis, mostly from the financial markets' perspective. Moreover, the paper entails an event study on the market effects of the ECB's announcements on some of its unconventional monetary policy measures.

Results

The literature review concludes that there are two scenarios under which a central bank should conduct unconventional monetary policy measures. Firstly, unconventional measures are warranted when an economy is heading towards a deflationary spiral or a liquidity trap. Secondly, these measures are warranted when the monetary policy transmission mechanism is impaired. As the transmission mechanism consists of several channels an impairment of any of these channels can require a central bank response.

A general overview of the key measures finds that, during the crisis, the ECB has mainly addressed problems in monetary policy transmission whereas disinflationary pressures have only started to mount recently. In order to support the monetary policy transmission, the ECB has adopted a more passive role in liquidity management by providing liquidity to the banking system in a more flexible manner than before. It has extended the maturities of its refinancing operations and relaxed some eligibility criteria in its collateral framework. The ECB has also provided liquidity in foreign currencies. In addition, it has conducted outright asset purchases and committed to Outright Monetary Transactions (OMT). The event study finds that the OMT announcement had an immediate and significant effect on stabilization of the euro area sovereign bond while the same cannot be said about the three-year longer-term liquidity providing operations. The great success of the OMT shows that a central bank backstop is needed in a financial crisis and that a credible commitment from the central bank to support the financial system can at times have even a larger impact than outright measures.

Keywords

Monetary policy implementation, unconventional monetary policy, monetary policy transmission, enhanced credit support, outright monetary transactions, longer-term refinancing operations

Abstract – Master's Thesis

Aalto University School of Business

Minna Kuusisto 28.2.2014

EKP:n kriisitoimet – konehuoneen näkökulma

Tutkielman tavoitteet

Tutkielman tavoitteena on käsitellä keskuspankin politiikkavaihtoehtoja finanssikriisin aikana rahapolitiikan toimeenpanon näkökulmasta. Lisäksi tavoitteena on tunnistaa tilanteet, joissa keskuspankin on turvauduttava epätavanomaisiin rahapolitiikkatoimiin. Tutkielma pyrkii antamaan yleiskuvan Euroopan keskuspankin (EKP) kriisitoimista sekä arvioimaan näiden toimien tehokkuutta rahoitusmarkkinoiden näkökulmasta. Tutkielma pitää sisällään myös event study -tutkimuksen, jossa arvioidaan joidenkin EKP:n epätavanomaisten toimien ilmoitusten markkinavaikutuksia.

Tulokset

Kirjallisuuskatsauksessa tunnistetaan kaksi tilannetta, jossa keskuspankin on turvauduttava epätavanomaisiin rahapolitiikkatoimiin. Epätavanomaiset toimet ovat perusteltuja, kun taloutta uhkaa deflaatiokierre tai likviditeettiloukku. Tällaiset toimet ovat myös perusteltuja, mikäli rahapolitiikan välittymismekanismi on rikkoutunut. Välittymismekanismi koostuu useista kanavista, ja minkä tahansa kanavan rikkoutuminen voi edellyttää toimia keskuspankilta.

Yleiskatsaus tärkeimpiin toimiin osoittaa, että kriisin aikana EKP on pääosin vastannut rahapolitiikan välittymismekanismin ongelmiin, kun taas paineet inflaation hidastumisesta ovat kasaantuneet vasta hiljattain. Rahapolitiikan välittymismekanismia tukeakseen EKP on omaksunut passiivisen roolin likviditeetinhallinnassa tarjoamalla likviditeettiä pankeille entistä joustavammin. Se on pidentänyt likviditeettioperaatioidensa maturiteetteja ja helpottanut joitakin vakuuksien kelpoisuusehtoja kehikossaan. EKP on myös tarjonnut pankeille likviditeettiä muissa valuutoissa kuin eurossa. Lisäksi se on tehnyt suoria arvopaperiostoja ja sitoutunut suoriin rahapoliittisiin kauppoihin (*eng. OMT*). Event study -tutkimus osoittaa, että OMT-ilmoituksella oli välitön ja merkittävä vaikutus euroalueen valtionlainamarkkinoiden vakaantumiseen toisin kuin 3v. pitempiaikaisilla likviditeettioperaatioilla. OMT:n suuri menestys osoittaakin, että keskuspankin ”takaajan” (eng. *backstop*) roolia tarvitaan finanssikriisissä, ja että keskuspankin uskottavalla sitoutumisella rahoitusjärjestelmän tukemiseen voi ajoittain olla jopa suurempi vaikutus kuin välittömillä toimilla.

Avainsanat

Rahapolitiikan toimeenpano, epätavanomainen rahapolitiikka, rahapolitiikan välittymismekanismi, tehostettu luotonannon tukeminen, suorat rahapoliittiset kaupat, pitempiaikaiset rahoitusoperaatiot

Table of contents

List of acronyms

ABS	Asset-Backed Security
ACC	Additional Credit Claims
BIS	Bank for International Settlements
CBPP	Covered Bond Purchase Program
CDS	Credit Default Swap
ECB	European Central Bank
EFSF	European Financial Stability Facility
ELA	Emergency Liquidity Assistance
EMU	Economic and Monetary Union
EONIA	Euro Overnight Index Average
ESCB	European System of Central Banks
ESM	European Stability Mechanism
ETF	Exchange-Traded Fund
EU	European Union
FOMC	Federal Open Market Committee
IMF	International Monetary Fund
LTRO	Longer-Term Refinancing Operation
MRO	Main Refinancing Operation
NCB	National Central Bank
OMT	Outright Monetary Transactions
PSI	Private Sector Involvement
QE	Quantitative Easing
SME	Small and Medium-sized Enterprises
SMP	Securities Markets Program
SRM	Single Resolution Mechanism
SSM	Single Supervisory Mechanism
TAF	Term-Auction Facility
VLTRO	Very Long-Term Refinancing Operation

List of tables and figures

List of figures

List of tables

Introduction

The RMS Titanic was the largest ship afloat at the time it entered service in 1912. As we know, the once state-of-the art passenger liner tragically sank only two and a half hours after colliding with an iceberg during its maiden voyage from Southampton to New York. Perhaps less well-known is the heroic self-sacrifice by the ship engineers. It has been said that by operating the pumps in the forward compartments which were filling with water, the engine room crew delayed the sinking for over an hour which was enough for nearly all the lifeboats to be launched. In addition, they kept the generators running to maintain power and lights throughout Titanic up until two minutes before the ship sank.

Is the European Economic and Monetary Union (EMU) a sinking ship? There have been times when at least the financial markets have perhaps thought so. The viability of the common currency, the euro, was first seriously questioned in 2012 around the partial restructuring of the Greek sovereign debt. At the time, the markets were worried about the debt sustainability of some euro area sovereigns as well as the cross-border exposures of banks in healthier countries to these sovereigns under distress. The ability of some sovereigns to refinance their debt in the market was questioned as the funding costs exploded as a result of rating downgrades and an investor run. Greece, Ireland and Portugal had already lost market access and Spain and Italy were feared to be the next in line. The European banking system was severely fragmented as the perceived risks related to the banks and the respective sovereigns generally walked hand in hand. The market fragmentation and the diverging paths of economic performance posed unprecedented challenges to common monetary policy conducted by the European Central Bank (ECB). The EMU, after little more than ten years of existence and still on its maiden voyage, was in distress.

Could the engine room crew be of any help in the ECB case? In monetary policy theory, a macroeconomic model of the transmission mechanism between short-term interest rates and the ultimate target of monetary policy determines the appropriate level of the policy rate for a central bank. Once the policy rate is set, it is the job of monetary policy implementation experts to conduct operations vis-à-vis the market to achieve the operational target of the monetary policy (Bindseil, 2011). Thus, whereas the *monetary policy framework* is involved with monetary economics and macroeconomic modeling, the *monetary policy implementation framework* is the set of tools and procedures that are used to achieve the operational target of monetary policy. One can think of

economists working in macroeconomic modeling as being in the captain's cabin, setting the direction for the ship, and monetary policy implementation experts as the engine room crew whose job is to ensure that the engines are running and the ship is moving in the first place.

In the storm that hit the financial markets, it was the engine room of the Eurosystem that felt the heat. Policy rates had been cut very close to zero which constrained the room for maneouvre in the conventional monetary policy space. In addition, the transmission mechanism was impaired, meaning that some of the channels through which the monetary policy transmits to the real economy were dysfunctional. There was a need for a broader perspective and a wider range of operational targets. This analysis required the expertise of the engine room, the monetary policy implementation specialists. As the conventional monetary policy was approaching the zero-lower bound and its effectiveness to support the transmission mechanism was limited, the ECB decided to conduct several unconventional measures. These measures were aimed at securing a proper monetary policy transmission mechanism and signaling the desired monetary policy stance.

This paper focuses on the ECB's monetary policy response to the financial crisis. The emphasis is on the unconventional measures but also the conventional measures are briefly discussed. Moreover, I conduct an event study on the market effects of the ECB's announcements on the three-year-longer term refinancing operations and the outright monetary transactions (OMT) program. In terms of immediate market reactions, I find that the OMT announcement was very effective and contributed to the stabilization of the sovereign bond market. However, the three-year refinancing operations did not have comparable effects. Rather their effect was dampened by the ongoing political uncertainty in Europe as well as serious fears of a euro break-up.

Regardless of the immediate effects, the euro area financial market, after more than six years of crisis, is currently enjoying a relative calm. It is indisputable that the ECB measures, overall, have at least partially contributed to this stabilization. Even though in terms of growth and economic stability, the euro area still is in a fragile state, the market environment is much less turbulent than two years ago. Future scholars will be able to better assess whether the ECB measures had a crucial role in the stabilization. Currently, it seems that the ECB engine room crew actually managed not only to keep a sinking ship afloat but indeed in buying enough time to repair the leaks and ensure the continuation of a safe journey.

The study is organized as follows. First, Chapter 1 presents the central bank policy options outlining the classification and the main characteristics of conventional and unconventional measures. Subsequently, Chapter 2 discusses the conventional measures and presents the ECB's crisis response in the conventional monetary policy implementation framework. Thereafter, Chapter 3 outlines the unconventional measures and discusses the ECB's crisis measures each in turn. Subsequently, Chapter 4 presents the data and the event study methodology and Chapter 5 discusses the main findings of the event study. Chapter 6 pursues a general assessment on the ECB's response as well as responds to some of the criticism the ECB has faced during the crisis. Finally, Chapter 7 concludes.

1 Central bank policy options

During the last few decades, there has been convergence in approaches among major central banks with respect to conventional monetary policy implementation (Borio C. , 2001) However, the same cannot be said about unconventional monetary policy measures. Since the onset of the financial crisis in 2007, unconventional measures have gained strong interest among economists and scholars. Due to novelty of the conducted measures and scarcity of research, the effectiveness of the unconventional monetary policy measures is still under debate. There is no universal view on the distinction between conventional and unconventional measures or an unambiguous taxonomy for the latter. Hence, in this chapter I will briefly discuss, what motivates central banks to take up hefty arms. I will also discuss some characteristics that distinguish conventional measures from unconventional ones. Section 1.1 gives an introduction on the central bank policy setting in normal times and presents scenarios in which central banks may need to resort to unconventional policy measures. Section 1.2 discusses the classification of conventional and unconventional measures.

1.1 When the Taylor rule is not enough

According to Borio and Disyatat (2009), the implementation of monetary policy has two key elements or objectives: signaling the desired policy stance and making that policy stance effective. For the first one, the major central banks have converged to an approach in which the policy stance is defined exclusively in terms of a short-term interest rate, the "policy rate".[1] Setting the target level for interest rates has been done judgmentally using a wide variety of macroeconomic

[1] Various scholars (Joyce;Miles;Scott;& Vayanos, 2012) and (Bindseil, 2004) point out to this type of convergence.

indicators but in a manner that could be approximated with reference to the so-called Taylor Principle; interest rates respond more than one on one to changes in inflation and to variations in output gap (Woodford, 2003, pp. 91). Under normal conditions, liquidity management operations are designed to help make that interest rate effective by influencing the scarcity of central bank money. These operations are necessary to achieve the operational target, normally, a level of short-term market rate close to policy rate.

The recent financial crisis, however, proved the conventional monetary policy framework with a policy rate and an implementation framework focusing on the operational target, a short-term rate, inadequate. Indeed, the recession in many economies was so deep that the Taylor rule would have implied negative nominal interest rates. Negative interest rates implied by Taylor rule posed a challenge since nominal interest rates are normally assumed to be bound by zero as agents can always hold non-interest bearing cash. (Joyce;Miles;Scott;& Vayanos, 2012) The *zero lower bound* (ZLB) is, thus, generally considered to constrain the conduct of conventional monetary policy. As a response to the crisis, all major central banks cut their policy rates to historical lows and fairly close to zero which roused the question whether these economies were heading towards a "bad" equilibrium.

The Keynesian lesson is that, in a recession, the economy might end up in a deflationary spiral and a liquidity trap. In a liquidity trap, the interest rates, bound by zero, cannot be lowered further and the economic agents are indifferent between holding money in cash and buying bonds, which makes additional monetary stimulus ineffective (Krugman;Dominquez;& Rogoff). Thus, an increase in money base would not lead to lower nominal interest rates. Due to deflation expectations, economic agents would be reluctant to consume because they would expect prices to fall in the future which would make central bank stimulus efforts ineffective. The expectations would then become a self-fulfilling prophecy and, due to the hoarding of liquidity, the economy might plunge into a deflationary spiral in which inflation and output decline over time (Evans;Guse;& Honkapohja, 2008).

Evans et al. (2008) acknowledges the possibility of multiple equilibria when monetary policy is conducted using a Taylor rule and concludes that liquidity trap and deflationary spiral are of a serious concern. The authors find that the steady-state equilibrium targeted by policymakers is locally stable. In other words, in normal times, monetary policy implementation following the

Taylor rule will appropriately stabilize inflation, consumption and output. However, the equilibrium is not globally stable and, thus, a large enough pessimistic shock can result in a deflationary spiral. They recommend aggressive monetary policy whenever inflation falls below a certain threshold and add that in case monetary policy alone is inadequate aggressive fiscal policy could be conducted. However, the authors prefer to use fiscal policy only as a last resort.

Another way to escape the liquidity trap is discussed in Eggertson et al. (2003). The authors emphasize the value and effect of a central bank's management of expectations. They conclude that a commitment by a central bank to keep interest rates low for a time in the future will create subsequent inflation even when deflationary expectations have evolved. In their model, the effect to aggregate demand comes through a change in the expected path of real interest rates. If the public believes in the central bank's commitment to keep the rates low for long and simultaneously expects inflation, real rates decrease, which would create an incentive to consume. In addition, Eggertson et al. (2003) conclude that open-market operations in the form of asset purchases are ineffective to the extent that they fail to change expectations regarding future policy. Management of expectations is further discussed in Section 3.2.6 which explains the concept of forward guidance.

Joyce et al. detect (2012) another significant challenge for the conventional monetary policy in times of crisis: the *impairment of the monetary policy transmission mechanism*. Reinhard H. Schmidt (2001) defines transmission mechanism as a formal model of the ways through which monetary policy influences the real economy. These are the i) interest rate channel, ii) the channel of relative prices (or asset price channel), iii) the credit channel and iv) the exchange rate channel[2]. The exchange rate channel is not discussed in Schmidt (2001). It can be defined as the channel that captures the effect of monetary policy on exchange rate (a policy rate cut would make domestic deposits less tempting). The exchange rate, in turn, has an effect on the price of imports and, ultimately, to price stability (Mishkin, 1996).

As defined in Schmidt (2001), the *interest rate channel* is based on the conventional IS – LM model, which assumes that with given and unchanged inflation expectations, the central bank can

[2] Also, when it comes to unconventional measures, scholars often recognize another important channel, the signaling channel. The signaling channel is discussed in chapter 3 with unconventional measures.

affect real long-term rates by determining the short-term rate. For this channel to function, two conditions need to be met. Firstly, the monetary policy must not only affect short-term rates but also medium to long-term rates[3]. Secondly, investment decisions need to be interest-elastic. The second channel, the one of *relative prices*, assumes that the central bank can influence the composition and/or prices of the assets which are held in the portfolios of economic agents. An unexpected monetary impulse can induce attempts for agents to adjust their portfolio compositions. This channel, also referred to as the portfolio-balance channel, is further discussed in Chapter 3.

According to Schmidt (2001), the third channel, the *credit channel*, can be further broken down into two separate but complementary channels. These channels are the balance sheet channel and the bank lending channel. The first one captures the effects of monetary policy to the balance sheets of firms and other borrowers. Since a restrictive monetary policy raises interest rates, it also depresses the net asset values of the borrower's assets in its portfolio and, thus, the value of their collateral, which restricts the borrower's financing options and raises the external finance premium[4]. The bank lending channel, in turn, captures the effect of monetary policy on the quantity of credit which the banking sector can provide to borrowers. An important implication is that these two credit channels reinforce each other, which makes their relevance for the effects of monetary policy all the greater.

Indeed, in the most intense phases of the financial crisis, the monetary transmission mechanism was impaired. Severe mistrust prevailed amongst the financial institutions and agents due to insolvency fears. Banks did not lend each other or the customers and the market liquidity dried out. Monetary stimulus provided by the central bank was no longer transmitted to the real economy because the bank lending channel was not functioning.

Cecioni, Ferrero and Secchi (2011) elaborate that the dysfunction of the transmission mechanism can either appear as the increase in the volatility of the demand for bank reserves (central bank liquidity) and limited redistribution of liquidity among the depository institutions or it may be a result from disruptions in other segments of financial markets. In other words, the problem can originate from the banking sector or from another sector in the economy. During the financial crisis, both of these threats realized. For some part, the impaired transmission mechanism reflected the

[3] This is normally done by managing expectations about the future path of interest rates.
[4] External finance premium is defined as the cost difference between external and internal financing (Schmidt, 2001).

tensions in the sovereign debt market as banks under distressed sovereigns transmitted the cost and risk of their exposure to the customers, but also, it reflected the fragmented banking system as the healthier banks stopped trading with the banks that had large exposures to peripheral sovereign debt. Several channels of monetary policy transmission were not functioning properly credit channel being, perhaps, most severely impaired.

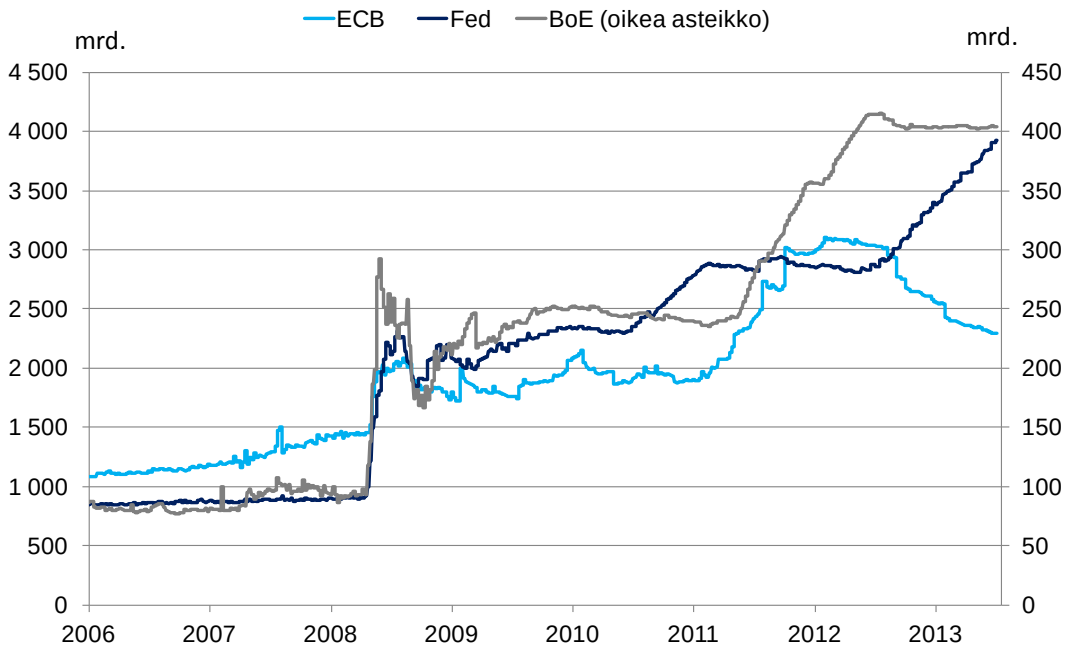
The discussion on central bank policy options can be concluded by acknowledging two shortcomings of conventional monetary policy that justify a central bank intervention. These two are the risk of the economy ending up in a deflationary spiral or a liquidity trap and/or an impairment of the monetary policy transmission mechanism. The first case, a liquidity trap, is only a serious concern once there is no longer room for manoeuvre in the policy rates i.e. when the rates are close to zero and, simultaneously, there is a risk of deflation. The second case, however, can constrain the effectiveness of conventional monetary policy even when the rates are above zero. In this case, the central bank needs to find other ways to signal its monetary policy stance and make that policy stance effective. Chapter 3 will later show how the ECB, indeed, has responded by conducting several unconventional measures. Before going to the actual measures it is, however, necessary to discuss the classification of conventional and unconventional measures and try to draw a line between the two, even if it is a thin one.

1.2 Conventional vs. unconventional options

There is no universal classification between conventional and unconventional measures. As Borio and Disyatat (2009) indicate in their paper, it is extremely difficult to draw a line between the two. In addition to conducting unconventional measures, the existing conventional measures can be "stretched". In other words, they can be intensified in scope, frequency and magnitude. This makes the classification less straight-forward. Some common characteristics can still be recognized. The common denominator for the different unconventional measures conducted in all major central banks during the crisis has been the expansion of balance sheet. In fact, Borio and Disyatat (2009) distinguish the conventional monetary policy to normally target the short-term (typically overnight) interest rate and unconventional monetary policy as active of the central bank's balance sheet to directly affect market prices and conditions beyond its regular operational target. Figure 1 presents the explosion of the major central bank balance sheets during the crisis. In this paper, I consider all the policies that have led to significant balance sheet expansion or showed a central bank diverging

from its normal operational target, de facto unconventional, even if they as such belong to the conventional monetary policy implementation framework.

Figure 2 Balance sheets of major central banks have expanded due to unconventional monetary policy measures.



Lähde: Bloomberg

Cecioni et al. (2011) point out that in addition to the difficulty in distinguishing conventional measures from unconventional measures, there is also an abundance of taxonomies available in the literature for the grouping of unconventional measures per se. Stone, Fujita and Ishi (2011) base their classification on whether the final objective of the unconventional measure is one of financial or macroeconomic stability. They categorize purchases of government bonds as macroeconomic stability policies and liquidity provisions as financial stability policies. Klyuev et al. (2009) divide unconventional measures into four: an explicit commitment to keep short-term rates low for a prolonged period, the provision of extraordinary amounts of low-cost financing to financial institutions, outright purchases of government securities to lower the long-term rate and outright credit market interventions.

Furthermore, Borio and Disyatat (2009) recommend taxonomy based on the particular financial market targeted by the measures and on their impact on the structure of private sector balance sheets. They distinguish between exchange rate policies, quasi-debt management policies, credit

policies and bank reserves policies. In an exchange rate policy, the central bank alters the net exposure of the private sector to foreign currencies by operating in the foreign exchange market. I will disregard this policy area in my study since, as Borio and Disyatat point out, exchange rate policies have often been used e.g. in emerging economies as conventional measures[5]. In quasi-debt management policy, the central bank alters the composition of claims on the public sector held by the private sector with an intention to alter the yield on government securities. A credit policy targets specific segments of the private debt and securities market by changing the central bank's exposure to private sector claims. Finally, in a bank reserves policy the central bank sets a specific target for bank reserves regardless of how this is counter-balanced on the asset side of its balance sheet. This approach, traditionally defined as quantitative easing, is further discussed in Section 3.1.1.

As for Papadia and Välimäki (2011), they distinguish three types of unconventional measures: quantitative easing, credit easing and enhanced credit support. Since their view is based on the terminology applied by the central banks, I will follow the same classification in my thesis. The following two chapters will elaborate the characteristics and instruments in conventional and unconventional monetary policy frameworks. Chapter 2 discusses conventional measures that focus on the short-term interest rate targeting without significant balance sheet expansion. Thereafter, Chapter 3 discusses unconventional measures and elaborates the classification of unconventional measures to quantitative easing, credit easing and enhanced credit support.

2 Conventional measures – steering short-term interest rates

As discussed in Chapter 1, before the crisis, the central banks of almost all advanced economies had arrived at a roughly similar monetary policy framework. During a period of great moderation, the central banks had gained independence in monetary policy and their transparency and accountability had also been enhanced (Stone, Fujita, & Ishi, 2011). Among the developed economies, inflation targeting had become the cornerstone of conventional monetary policy framework.

[5] central banks have routinely intervened in the market to attain their exchange rate target but the liquidity effect of these purchases has been sterilized through, for example, issuance of central bank bills

Within the conventional monetary policy framework, the setting of interest rates has been done in a manner that could be approximated with reference to the so-called Taylor rule (Woodford, 2003, s. 90). Once the policy rate is set, it is the job of the monetary policy implementation experts to use the right instruments in the chosen operational framework to achieve the operational target of the monetary policy. Normally, this operational target is a short-term market rate which is desired to closely follow the policy rate. According to Bindseil (2011), monetary policy implementation consists of two key elements: first, establishing an operational framework to control the selected operational target (e.g. setting up the instruments) and second, using these instruments on a daily basis to influence the scarcity of central bank money and to achieve the operational target of the central bank (i.e. liquidity management).

Borio & Disyatat (2009) elaborate the concept of scarcity of central bank money. They point out that the market for bank reserves is in the core of the implementation of conventional monetary policy. . In this market, the central bank is the monopoly supplier. The central bank can set the quantity of money and the terms on which it is supplied at the primary market. Thus, the central bank can steer the secondary market price for reserves, the overnight rate, to any particular level by standing ready to buy and sell unlimited amounts of money at the chosen price. Importantly, the central bank can set the interest rate independently of the amount of bank reserves in the system. According to this decoupling principle, the same amount of bank reserves can coexist with different levels of interest rates – and the other way around.

2.1 ECB monetary policy implementation framework

This chapter presents the overall monetary policy implementation framework of the Eurosystem by introducing its main objectives, tasks and instruments. The chapter is organized as follows: after the general overview of the framework, I go through the three main instruments in monetary policy implementation. First, I discuss reserve requirements. Secondly, I outline the open-market operations that divide into five categories. Thirdly, I explain the role of standing facilities in monetary policy implementation. Finally, I outline the main features of the Eurosystem collateral framework.

The ESCB consists of the European Central Bank and the national central banks (NCBs) of the EU Member States that conduct single monetary policy. Those EU Member States whose currency is

not the euro are not involved in the conduct of the single monetary policy. Thus, they are not part of the Eurosystem. The ESCB acts in accordance with the Treaty on the Functioning of the European Union (henceforth called the Treaty) and the Statute of the European System of Central Banks and of the European Central Bank. (ECB, 2011)

The main decision-making body of the ECB is the Governing Council (GC) which is responsible for the formulation of monetary policy. The Executive Board of the ECB implements the monetary policy according to the decisions made and guidelines laid down by the Governing Council (ECB, 2011, p. 9). The Governing Council is comprised of the NCB Governors of the member states[6] and the members of the Executive Board. Each GC member has one vote in the GC meetings. Whereas the policy stance is determined by the GC, the operational implementation of the monetary policy is decentralized and carried out in NCBs.

The primary objective of the Eurosystem, stated in the Treaty, is to maintain price stability. (EU, 2012, p. 167) According to the ECB's monetary policy strategy that was presented in October 1998 and re-evaluated in May 2003, the price stability objective of the ECB is to maintain inflation[7] for the euro area below but close to 2 % in the medium term (ECB, 2003). The basic tasks to be carried out through the Eurosystem are: defining and implementing the monetary policy of the currency union, conducting foreign-exchange operations consistent with the provisions of Article 219, holding and managing official foreign reserves of the Member States and promoting the smooth operation of payment systems. (EU, 2012, p. 102)

In order to achieve its objectives, the Eurosystem applies a set of monetary policy instruments. This set includes open market operations, standing facilities and a requirement for credit institutions to hold minimum reserves on accounts with the Eurosystem. (ECB, 2011) These instruments are discussed one by one in the following sections.

The Eurosystem's operational framework has some unique features in comparison with other major central banks. Cour-Thimann and Winkler (2013, s. 8) take note of the special design of euro area liquidity provision. Indeed, the ECB framework enables a participation of a large number of credit

[6] Throughout this document, the term 'Member State' refers to a Member State whose currency is the euro.
[7] measured by the year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area

institutions. In fact, out of the roughly 6300 credit institutions established in the euro area, around 2200 fulfill the operational criteria for participation in the Eurosystem open-market operations[8].

Borio (2001) notes that the ECB has chosen a different type of policy rate than e.g. Federal Reserve and the Bank of Japan. Whereas, for the latter the policy rate is the announced target level for overnight market rate, the ECB's policy rate is the rate of its main refinancing operation. Importantly, the author points out, that this allows the Eurosystem somewhat greater freedom in tolerating deviations of the overnight rate from the policy rate, if and when required. The ECB, also, has not explicitly stated its operational target. Another unique feature of the Eurosystem is the existence of standing facilities as none of this type of on-demand liquidity facilities exist in US or Japan. Also, the spectrum of eligible collateral is considerably broader in the Eurosystem as it is in the US.

2.1.1 Minimum reserve requirements

The Eurosystem's minimum reserve system applies to credit institutions in the euro area and pursues two aims: stabilizing short-term money market interest rates and creating or increasing a structural liquidity shortage of the euro area banking sector[9]. As a result, the banking system in euro area has a structural liquidity deficit, i.e. the banks need central bank funding.

The reserve requirement of a credit institution is determined in relation to elements of its balance sheet, more precisely, in relation to its deposits and short-term debt. In order to pursue the aim of stabilizing interest rates, the Eurosystem's minimum reserve system enables institutions to make use of averaging provisions. The calendar year is divided into twelve reserve maintenance periods over which the institutions are obliged to, on average; hold the minimum reserve amount on their reserve account at the central bank. Institutions' holdings of required reserves are remunerated at the rate of the Eurosystem's main refinancing operations. Thus, in the Eurosystem, the reserve requirement system is not a financial burden to credit institutions. (ECB, 2011, pp. 53-54) Also, the

[8] Approximately 200-400 institutions usually participate. There are fluctuations however: for the second 3-year LTRO, for example, 800 banks participated.

[9] In addition to minimum reserve requirements, there are other factors that effect on the liquidity position of the banking system vis-a-vis the central bank. These autonomous factors are beyond the steering of the monetary policy and they include e.g. central bank's foreign reserves and euro-denominated reserves as well as banknotes. The effect of these autonomous factors adds to the liquidity shortage in the banking system.

averaging provision enables a bank to optimize on the cost of holding reserves by maintaining them whenever it assumes the cost of it to be the lowest during that averaging period (Välimäki, 2001).

Borio and Disyatat (2009, s. 3) argue that the central bank remuneration scheme is a key issue in the market for bank reserves. Normally, central banks remunerate excess reserve holdings – i.e. holdings over and above any minimum reserve requirement – at a rate that is below the policy rate. As a result, banks seek to economize them, keeping on the reserve (current) account only the amount that corresponds to its settlement purposes. Supplying this amount (the structural liquidity deficit and reserve requirements) is a key task of the central bank. Supplying an excess amount of liquidity, would drive the overnight rate to the floor set by the remuneration on excess reserves. On the other hand, any shortfall in liquidity would drive the overnight interest rates up. This relation between the short-term market rates and central bank liquidity management are further discussed in Section 3.2.1.

The ECB has decided not to remunerate excess reserves but, instead, provides its counterparties with standing facilities which set the corridor for the overnight rates. A counterparty of a Eurosystem central bank can transfer any excess liquidity on a daily basis from the current account to the deposit facility and, thus, get the remuneration rate of the deposit facility on their excess reserves. On the opposite, a counterparty of the Eurosystem can obtain any shortfall in liquidity on a daily basis from the marginal lending facility at the cost of the marginal lending rate against eligible collateral. Hence, in the euro area, the corridor for the market overnight rate is determined by the ECB deposit rate (sets the floor) and the marginal lending rate (sets the ceiling for the market overnight rate).

2.1.2 Open-market operations

The ECB general documentation (ECB, 2011, p. 13) defines the role of open-market operations as steering interest rates, managing liquidity situation and signaling monetary policy stance by affecting the amount of liquidity in the banking system. This is done by either providing liquidity to the system or absorbing liquidity from it.

Market operations can be divided into five instrument groups. First of all, the ECB can conduct *reverse transactions* where the it provides loans against eligible collateral for credit institutions that

fulfill the counterparty criteria[10]. Reverse transactions are the most common instrument for open-market operations. In addition, the *ECB can use outright transactions, issue debt certificates, conduct foreign exchange swaps* and *collect fixed-term deposits.* Open-market operations are initiated by the ECB and they can be executed as standard tenders, quick tenders or bilateral procedures. During the crisis, the ECB has utilized a wide range of the instruments presented above.

The following list summarizes the basic tender types[11]. Some of the instruments mentioned in the previous paragraph can be utilized in different types of tenders (figure 2).

i. *The main refinancing operations* (MROs) are regular liquidity-providing reverse transactions with a weekly frequency and a maturity of normally seven days. The MROs are executed by the NCBs as standard tenders.
ii. *The longer-term refinancing operations* (LTROs) are liquidity-providing reverse transactions with a monthly frequency and a maturity of normally approximately 3 months. Also these tender operations are executed by the NCBs on the basis of standard tenders.
iii. *Fine-tuning operations* (FTOs) are carried out on an ad-hoc basis with the aim of managing liquidity situation in the market and steering interest rates, in particular in order to smooth the effects caused by unexpected liquidity fluctuations in the market. (ECB, 2011, p. 14)[12]
iv. Finally, the ECB can execute *structural operations* through the issuance of ECB debt certificates, reverse transactions and outright transactions. In these operations, the ECB wishes to adjust its structural position vis-à-vis the financial sector. The first two are normally carried out by the NCBs through standard tenders, whereas outright transactions

[10] The Eurosystem's monetary policy framework is formulated with a view to ensuring the participation of a broad range of counterparties. Institutions subject to minimum reserve requirements and fulfilling other criteria may, according to Article 19.1 of the Statute of the ESCB, access the standing facilities and participate in open market operations based on
standard tenders as well as outright transactions. Nevertheless, the Eurosystem has limited the number of counterparties that can participate in fine-tuning operations and foreign exchange swaps. For further information about eligibility criteria, see (ECB, The Implementation of Monetary Policy in the Euro Area, 2011).

[11] These tender types have been adjusted during the crisis. The ECB has conducted unconventional measures and e.g. extended the maturity of longer-term-refinancing operations, even up to 3 years.

[12] During the crisis, these types of tenders were usually conducted on the last day of a reserve maintenance period to counter liquidity imbalances. Also, the ECB has conducted fine-tuning liquidity-absorbing tenders on a weekly basis ever since it launched its Securities Markets Program (SMP) which is discussed later in Section 3.2.5. The purpose of these liquidity-absorbing tenders has been to sterilize the liquidity effect of Eurosystem's SMP purchases by collecting deposits from credit institutions for an amount that corresponds to the outstanding volume of SMP holdings in Eurosystem.

are executed by the NCBs through bilateral procedures. (ECB, 2011, p. 15) These structural operations have not been conducted in the Eurosystem.

Figure 3 ECB monetary policy operations (ECB, 2011)

Table 1

Eurosystem monetary policy operations

Monetary policy operations	Types of transactions		Maturity	Frequency	Procedure
	Provision of liquidity	Absorption of liquidity			
Open market operations					
Main refinancing operations	Reverse transactions	—	1 week	Weekly	Standard tenders
Longer-term refinancing operations	Reverse transactions	—	3 months	Monthly	Standard tenders
Fine-tuning operations	Reverse transactions Foreign exchange swaps	Reverse transactions Collection of fixed-term deposits Foreign exchange swaps	Non-standardised	Non-regular	Quick tenders Bilateral procedures
Structural operations	Reverse transactions	Issuance of ECB debt certificates	Standardised/ non-standardised	Regular and non-regular	Standard tenders
	Outright purchases	Outright sales	—	Non-regular	Bilateral procedures
Standing facilities					
Marginal lending facility	Reverse transactions	—	Overnight	Access at the discretion of counterparties	
Deposit facility	—	Deposits	Overnight	Access at the discretion of counterparties	

2.1.3 Standing facilities

According to the general documentation (ECB, 2011, p. 10), standing facilities are aimed at providing and absorbing overnight liquidity, signal the general stance of monetary policy and bound overnight interest rates. Two standing facilities are available to eligible counterparties on their own initiative, subject to their fulfillment of certain operational access conditions. These are the deposit facility and the marginal lending facility.

i. *Deposit facility*

Counterparties can use the deposit facility to make overnight deposits with their respective NCBs. Under normal circumstances, there are no deposit limits or other restrictions on counterparties' access to the facility. The interest rate on the deposit facility sets a floor for the overnight market interest rate since the counterparties always have the option to park their money at the central bank.

ii. *Marginal Lending Facility*

Counterparties can use the marginal lending facility to obtain overnight liquidity from their respective NCBs against eligible collateral. As for the deposit facility, under regular circumstances, there are no credit limits or other restrictions for counterparties apart from the requirement of sufficient collateral. Opposite to the deposit facility, the marginal lending facility sets the ceiling for the overnight market interest rate since the counterparties always have the option to borrow from the central bank as long as they have adequate collateral.

As the deposit facility sets the floor and the marginal lending facility sets the ceiling for the overnight market rates, together they determine the band in which the overnight market rates can fluctuate. This band is called the interest rate corridor.

2.1.4 Collateral framework

The starting point of the ECB's liquidity provision is that all the credit operations, be it liquidity-providing tender operations, marginal lending or intra-day credit, are based on adequate collateral. Naturally, the ECB (or the Eurosystem) has several eligibility criteria for the collateral it accepts in its credit operations. Compared to other major central banks, the Eurosystem has, since its inception, been accepting a broad range of assets as collateral. This choice is due to the historical, structural and institutional differences that were in place across national central banks prior to the introduction of the single framework. (ECB, 2013)

The “Single List” was established in 2007 to replace the previous two-tier system that had been in place since the start of the EMU and unified the euro-area wide eligibility criteria. It covers marketable and non-marketable assets that fulfil uniform euro area-wide eligibility criteria specified by the Eurosystem. No distinction is made between marketable and non-marketable assets with regard to the quality of the assets and their eligibility for the various types of Eurosystem monetary policy operations, except that non-marketable assets are not used by the Eurosystem for outright transactions. All eligible assets may be used on a cross-border basis by means of the correspondent central banking model (CCBM) and, in the case of marketable assets, through eligible links between Union securities settlement systems (SSSs). (ECB, 2011)

Bindseil (2011) explains that a collateral framework will have to achieve an optimal balance between three main factors: cost of handling and analyzing collateral, central bank risk-taking and sufficient availability of collateral to allow for a smooth implementation of monetary policy. The author recognizes seven desirable properties on eligible collateral all of which affect the level of haircut that the central bank imposes on an asset that is used as collateral. The first prerequisite is the *legal certainty* of a claim. It means that the central bank needs to make sure that in case of a default it has the right to appropriate and liquidate the asset. Second, the central bank needs to set a *credit quality* threshold because low-rated assets have a higher probability of downwards migration (further downgrades) and because low-rated assets tend to be less liquid. Third, the central bank needs to evaluate the *simplicity* of the asset as complexities can lead to central bank losses if not properly addressed through haircuts. Fourth, the central bank also needs to address the issues of *market transparency/ price availability* as, again, securities that do not have a market price but instead need to be priced theoretically, require more central bank resources. *Market liquidity* is another issue which is to be addressed since illiquid assets are harder to price and cannot be sold as easily as the liquid ones in the case of a counterparty default. Sixth, the central bank also needs to evaluate the *costs of handling and settlement* of the collateral. Finally, there is the issue of *currency denomination*. Even though central banks normally limit collateral eligibility to assets denominated in their own currency, the procedure might change in a crisis. Indeed, this is what happened in the Eurosystem. I will return to this issue later in this chapter.

2.2 ECB conventional measures – historically low policy rates

This section outlines the conventional monetary policy measures conducted by the ECB since the onset of the financial crisis in 2007. The timeline of the crisis vaguely follows the presentation by Trichet (2012). I distinguish three phases and discuss them one by one. The first phase, 2007-2009, was the time of extreme financial turbulence with its epicenter in the US. In the second phase, 2010-2011, the focus shifted to the euro area where sovereign insolvency fears destabilized the sovereign debt market. This second phase ended in relative calm after the international bailouts. The third phase, from 2011 onwards, marked the episode of re-escalation in the euro area debt crisis where the future and viability of the Eurosystem and the common currency were seriously questioned. The ECB's conventional monetary policy responses to these crises are discussed next.

In the course of the financial market crisis that burst in the US in 2007 and culminated in the failure of Lehman Brothers in September 15th 2008, the ECB worked along all other major central banks and lowered its key policy rate (rate of the main-refinancing operation) multiple times. Trichet (2012) defines this approximately two-year period, starting from mid-2007, as an episode of financial turbulence that intensified dramatically after the collapse of Lehman Brothers. During the period of July 2008-May 2009, the ECB lowered its main-refinancing rate by 325 bps to 1 % (ECB, Statistics: Key ECB Interest Rates). In addition, in October 2008 the Governing Council of the ECB decided that the weekly main refinancing operations would be carried out through a fixed rate tender procedure with full allotment[13]. Furthermore, the ECB reduced the corridor of standing facilities from 200 basis points to 100 basis points around the interest rate on the main refinancing operation (ECB2008c).

Trichet (2012) notes, that from the ECB's point of view the subsequent phase of the crisis was even more important than the first one. The financial crisis had led to a deep global recession which had revealed severe vulnerabilities in some euro area countries' fiscal positions. Until 2010, dealing with divergent sovereign bond yields did not represent a challenge for the ECB. However, the perception of all euro area government bonds being equal in terms of risk was no longer valid as the markets started to worry about a possible Greek insolvency.

[13] The fixed rate and full allotment procedure will be discussed in further detail in Section 3.2.1.

During the first half of 2011, the market turbulence had somewhat abated and as a response to rising inflation expectations, the ECB decided to raise its main-refinancing rate twice (April and July). However, as the crisis intensified again towards the end of the year, the ECB again rebated the main-refinancing rate to 1% by lowering it in November and in December. More interestingly, in December 2011 the ECB made an unprecedented move and lowered the reserve requirement ratio from 2% to 1%, reducing the structural liquidity deficit and freeing an additional €100 billion in banking system liquidity (ECB2011e). The lower need for central bank refinancing could also free collateral for other uses of counterparties. In July 2012, the ECB lowered its main-refinancing rate to a new historical low of 0,75% which meant that, the interest rate corridor being symmetric at 150 bps, the deposit rate was set to zero. In May 2013, the ECB further cut the main refinancing rate by 25 bps to 0,50 % simultaneously narrowing the interest rate corridor to 100 bps and thus reducing the marginal lending rate to 1 % while the deposit rate maintained at 0 %. Furthermore, in November 2013, the ECB cut the main refinancing rate by 25 bps to 0,25 % and, for the first time, applied an asymmetric interest rate corridor as it left the deposit rate unchanged to 0 % but lowered the marginal lending rate by 25 bps to 0,75 %.

In addition to providing stimulus by aggressive lowering of the main policy rate, the ECB conducted several other measures to safeguard the transmission mechanism of its policy stance in years 2007-2009. The bunch of these measures included e.g. the lengthening of maturities in liquidity provision, expansion of the list of assets eligible as collateral, the provision of liquidity in foreign currency and outright asset purchases. Though many of these were only “upgraded” conventional measures in terms of scope and magnitude, they can also be classified as unconventional measures, credit easing or enhanced credit support, as the ECB would say. The next chapter will present all the significant unconventional policy measures or significant changes in the conventional framework conducted by the ECB in years 2007-2013.

3 Unconventional measures – expanding operational targets

Signaling the desired policy stance and making that stance effective are key objectives of monetary policy implementation. The key instrument for signaling is the policy rate. However, the crisis has shown that especially for the achievement of the latter objective the conventional means, sometimes, simply do not suffice. In other words, steering the short-term interest rates may not be enough of an operational target for the central bank when the transmission of the policy rate to the

real economy can be hampered. To cement the desired policy stance and make it effective, it is sometimes necessary to implement further measures. The major central banks have labeled these measures as quantitative easing, credit easing or enhanced credit support. These measures amplify the signaling effect of monetary policy but can also affect through other channels. This chapter will first discuss the three approaches of unconventional monetary policy. I will conclude the chapter by explaining how these unconventional measures transmit to the economy.

In addition to the transmission channels discussed in Chapter 2, scholars[14] recognize two channels through which the unconventional monetary policy measures are transmitted to the real economy, the *signaling channel* and the *portfolio-balance channel*. Firstly, the signaling channel is activated through central bank's communications. Its aim is to inform the public about the central bank's intentions regarding the future development of short-term interest rates [or any other objective the unconventional intervention may have]. In the literature, the signaling channel has been emphasized as the mechanism to escape the zero lower bound on nominal interest rates. Furthermore, exploiting the signaling channel during a time of financial turbulence can reassure the markets on the central bank's backstop role and thus improve the functioning of the monetary policy transmission mechanism (Cecioni;Ferrero;& Secchi, 2011). It is worthwhile noting that not all forms of exploitation of the signaling channel are unconventional per se. Since the 1990s managing expectations (eg. inflation expectations) has become a crucial task of the central bank and its monetary policy.

Transparency is the key challenge in signaling. Stone et al. (2011) define transparency as the public's ability to understand the central banks' motives and actions. They argue that the transparency choice is a trade-off; on one hand, between gaining justification and democratic accountability and thus increasing the effectiveness of the measures and, on the other hand, knowing that there is normally a lot of ex-ante uncertainty regarding the future of the current unconventional measures. A key concept here is forward guidance which has recently gained more attention as major central banks have applied it. Forward guidance is further discussed in Section 3.2.6.

[14] Borio and Disyatat (2009) and Cecioni et al. (2011)

Secondly, the portfolio-balance channel works through the impact of central bank operations on the composition of private sector portfolios (Borio & Disyatat, 2009). The nature of this mechanism was early described in Money, Capital and Other Stores of Value (Tobin, 1961). Tobin defined the portfolio adjustment as a response to increase in the quantity of money. Central banks could affect asset prices and, thus, real investment decisions by altering the relative supplies of financial claims with different durations (or maturities) and liquidity (Joyce;Miles;Scott;& Vayanos, 2012). Hence, in literature, the portfolio-balance channel is often linked to central bank asset purchases. In fact, e.g. Joyce, Lasaosa and others (2010) conclude in their paper, that the asset purchases conducted by the Bank of England had significant effects on gilt yields and that the impact came mostly through the portfolio balance channel. Imperfect substitutability between assets is a prerequisite for the functioning of the portfolio-balance channel (Borio & Disyatat, 2009 and Cecioni;Ferrero;& Secchi, 2011). For example, in a time of financial tensions, private agents (such as banks) may prefer cash over other assets. They may regard cash and liquid government bonds as imperfect substitutes. By issuing more reserves (money) and buying assets (government bonds) from the market, the central bank alters the composition of the private sector balance sheet. The private sector will end up holding less government bonds and more cash in its portfolio.

IMF staff paper (2013, s. 10) further distinguishes two channels in portfolio balancing; *scarcity channel* and *duration channel*. The scarcity channel implies that a very large buyer such as a central bank can reduce the supply of a specific bond available for trading. In that case, the investors who have a particular preference for the bond will bid up its price, as well as its close substitutes. The duration channel works in the way that when the central bank buys very large amounts of long-maturity bonds, investors' portfolios become safer due to lower exposure to interest rate risk. As a result, investors are willing to accept lower yields to hold all remaining bonds implying a downward shift of the entire yield curve. In other words, by increasing the demand for government bonds, the central bank can, due to maturity mismatch challenge, also encourage demand for other assets that are considered close substitutes to government bonds. For example, pension funds normally match the maturity of their assets and liabilities. If the supply of government bonds decreases (because of central bank purchases), pension funds need to compensate for those assets and perhaps buy other assets with equal maturities (Joyce;Miles;Scott;& Vayanos, 2012).

3.1 Classification of unconventional measures

3.1.1 Quantitative easing

The concept of quantitative easing (QE) has been widely used by the public and the media on a range of measures that the major central banks have conducted during the crisis. Nevertheless, the concept has been steered clear of by the bulk of central banks. In his paper from 2002, Masaaki Shirakawa, who later became the Bank of Japan governor, claims that in 2001 the Bank of Japan (BOJ) had adopted a new framework for monetary easing, so-called 'quantitative easing' (Shirakawa, 2002). Other papers have recognized the same official starting point for QE in Japan (Ugai, 2007). However, the action that Shirakawa was referring to was not articulated by the Bank of Japan as 'quantitative easing'. At the time, the press release from March 2001 that introduces some unprecedented and drastic measures in monetary policy, called the action 'monetary easing' not 'quantitative easing' (BOJ, 2001). Nevertheless, it is safe to say that even though the concept had already been used by several critics in the late 1990s, it was in the 2000s that quantitative easing really established its status in language and rhetoric of central bankers.

As is the case with several issues regarding unconventional monetary policy measures, there is no consensus about the definition of quantitative easing. According to Ugai (2007), quantitative easing in Japan consisted of three pillars: 1) a new operational target for money market operations i.e. reserve balances held by banks at BOJ instead of the overnight call rate, 2) a conditional commitment to maintain high reserve levels into the future and 3) an increase in the amount of outright purchases of Japanese government bonds to facilitate the attainment of the bank reserves target. Papadia and Välimäki (2011) agree with Ugai about the quantitative easing having bank reserves as its operational target. In other words, quantitative easing distinguishes from other balance sheet expanding policies because it focuses on the liability side of the central bank balance sheet whereas other policies (such as credit easing) focus on the asset side. The chairman of Federal Reserve, Ben Bernanke, adopted the same reasoning in his speech about the central bank's policy response in early 2009 (Bernanke, 2009). As such, this justification closely resembles the concept of bank reserves policy, introduced in Borio and Disyatat (2009), by which the authors classify it as a policy where the central bank sets a specific target for bank reserves regardless of how this is counter-balanced on the asset side of its balance sheet. Nevertheless, as Borio and Disyatat point out, there are several scholars who conclude that any policy that leads to an expansion of bank reserves should be called quantitative easing.

On contrary to Federal Reserve (Bernanke, 2009) and ECB (Trichet, 2009), that have named their respective crisis responses different from quantitative easing regardless of the increase in bank reserves, Bank of England (BOE) has been very explicit about its quantitative easing policy. However, BoE does not communicate its quantitative easing policy via a target in bank reserves like BOJ. Rather, the central bank articulates its quantitative easing policy as asset purchases financed by central bank money (Joyce, Tong, & Woods, 2011). Thus, the outcome is the same – the bank reserves held at the central bank expand since the central bank funds its purchases by issuing more reserve money. However, unlike Japan, the BoE does not explicitly state that it targets an increase in bank reserves. In April 2013, the BOJ explicitly announced a target for the annual pace of monetary base growth to 60-70 trillion yen which corresponds to 12-14 % of GDP[15]. (BOJ, 2013).

Regarding the implementation of quantitative easing policies, the BOE and BOJ have mainly exploited asset purchases. In the United Kingdom, the asset purchase program dubbed as quantitative easing has been the backbone of its unconventional monetary policy since it was launched in the beginning of 2009. In May 2013, the BOE had created £375 billion corresponding to 24 % of GDP worth of central bank reserves to finance purchases of assets that are mainly UK government bonds[16] (BOE, Asset Purchase Facility Results [online]). After a decades-long battle with deflation and weak economy, the BOJ announced, in April 2013, to enter a new phase of monetary easing in terms of quantity and quality (BOJ, 2013). In an unprecedented announcement of unconventional monetary policy measures, the central bank announced to double the monetary base and the amounts of Japanese government bonds (JGB) as well as exchange-traded funds (ETFs) it holds. In addition, it would more than double the average remaining maturity of JGB purchases.

It is evident that outright government bond purchases have been the key instrument in quantitative easing. However, BOJ and BOE have not been the only major central banks to conduct outright asset purchases. Indeed, also Federal Reserve and ECB have conducted asset purchases. Subsequently, I present a second concept of unconventional monetary policy i.e. credit easing that has been introduced by the Federal Reserve. Though it carries several similar elements with regard to quantitative easing, the starting point and the objectives are different.

[15] GDP figures are based on IMF World Economic Outlook Database, end of 2012 figures.
[16] The BOE has also bought a relatively small amount of corporate bonds but these purchases constitute 0,5 % of total purchases.

3.1.2 Credit easing

Credit easing differs from quantitative easing with respect to its objectives and focus. Policies of credit easing and enhanced credit support channel credit to the most relevant sectors in a targeted manner. The objective is to stimulate the flow of credit beyond what could be achieved by steering short-term interest rates. Thus, the focus of these policies is on the asset side of the central bank's balance sheet. Furthermore, in the purest form of credit easing or enhanced credit support, the central bank offsets the liquidity injections resulting from the credit operations. (Papadia & Välimäki, 2011: 230.) The term credit easing has been used by Federal Reserve during the financial crisis.

In his speech in London on January 2009, the Fed chairman Bernanke, gives a clear definition to the Federal Reserve's credit easing policy: "*The Federal Reserve's approach to supporting credit markets is conceptually distinct from quantitative easing (QE), the policy approach used by the Bank of Japan from 2001 to 2006. Our approach--which could be described as "credit easing"--resembles quantitative easing in one respect: It involves an expansion of the central bank's balance sheet. However, in a pure QE regime, the focus of policy is the quantity of bank reserves, which are liabilities of the central bank; the composition of loans and securities on the asset side of the central bank's balance sheet is incidental. - - In contrast, the Federal Reserve's credit easing approach focuses on the mix of loans and securities that it holds and on how this composition of assets affects credit conditions for households and businesses*." (Bernanke, 2009.)

The Federal Reserve reasons its approach with the differences in financial and economic conditions between the United States and Japan. According to Bernanke (2009), the credit spreads were much wider and the credit markets more dysfunctional in the US than they were in Japan. The circumstances required differents responses. The challenge in credit easing versus quantitative easing is the lack of a simple numeric measure or policy target which, according to Bernanke (2009), puts further pressure on communication issues and transparency to ensure that the public and the markets will shape their expectations accordingly.

According to official statements by the Federal Reserve (Federal Reserve Monetary Policy Statements [online]), the aims of credit easing have been to lower longer-term interest rates and to ease overall financial conditions. The actions have been divided into three groups: 1) provision of

short-term liquidity to banks and other financial institutions, 2) provision of liquidity directly to borrowers and investors in key credit markets and 3) expansion of the traditional tool of open market operations to support the functioning of the credit markets through outright purchases of longer-term securities. The first group of tools has included several liquidity provision facilities for banks and primary dealers[17]. The second set of tools has involved e.g. Commercial Paper Funding Facility and provision of liquidity to money market funds. The third set of tools has included outirght purchases of government bonds and mortgage-backed securities.

Credit easing can be quite easily confused with enhanced credit support. However, the former differs from the latter with respect to its intermediary channels. In the specific case of credit easing, the idea is to improve conditions in the private credit markets, without using the banking system as an intermediary. In contrast, enchanced credit support is concentrated on improving the refinancing opportunities of the banking system, with a view of supporting the provision of credit to the real economy (Papadia & Välimäki, 2011: 230-231.) The next section will explain the concept of enhanced credit support in further detail.

3.1.3 Enhanced credit support

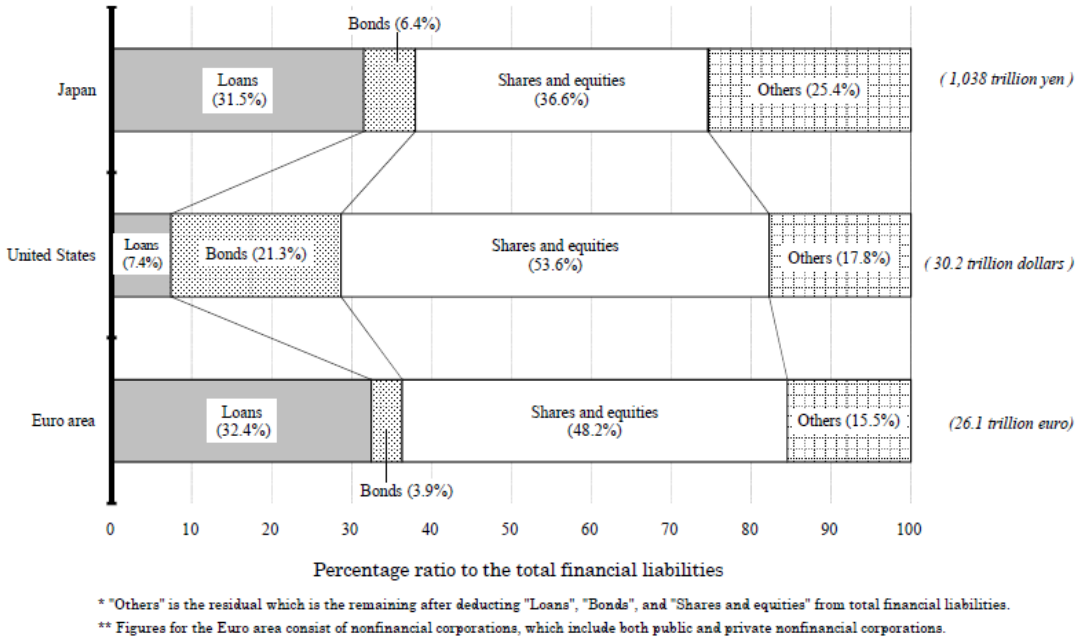
Enhanced credit support resembles credit easing in a way that they both focus on the asset side of the central bank's balance sheet. This characteristic distinguishes these two policies from quantitative easing. On the other hand, they differ in terms of intermediation channel, since credit easing directly targets credit markets whereas enhanced credit support aims at supporting the credit market via the banking system. Enhanced credit support has been conducted by the ECB due to several reasons that relate to the characteristics of the euro area economy.

Jean-Claude Trichet[18] (2009) introduced the term enhanced credit support to describe the unconventional monetary policy action conducted by the ECB. A different approach in comparison to Fed was needed due to the diverse characteristics of the financial accounts of nonfinancial corporate sector in the euro area in comparison with the United States. In the euro area bank financing accounts for a significantly larger share of firms' external financing than in the US (Cour-Thimann & Winkler, 2013). This is demonstrated in 3, which shows that bank loans play a much

[17] also for foreign banks via special swap arrangements with other major central banks
[18] Served as the President of the ECB from November 2003 to October 2011

more significant role in the euro area than they do in the US where market-based financing plays a larger role. To elaborate, Trichet recognized three characteristics of the euro area economy that served as a prerequisite for a different monetary policy response at the onset of the financial crisis: Firstly, small and medium-sized enterprises that normally rely on bank financing instead of market financing, play a pivotal role in the euro area. Secondly, the housing market was not the epicenter of the crisis in Europe as it was in the US, but rather the fact that many banks had toxic assets on their balance sheet that were backed by US mortgage loans. Thirdly, the wages and prices are more rigid in the euro area than in the United States (Trichet, 2009.)

Figure 4 The difference in financial accounts of private nonfinancial corporations in major economies. The share of bank loans is 32.4 % in the euro area compared to 7.4 % in the US. (BOJ, Bank of Japan Statistics, 2013)



Trichet (2009) defines the concept of enhanced credit support as follows: "*enhanced credit support constitutes the special and primarily bank-based measures that are being taken to enhance the flow of credit above and beyond what could be achieved through policy interest rate reductions alone.*" In his definition, Trichet addresses the exact issues which, according to economic literature, pose challenges to the conduct of conventional monetary policy. Firstly, there was a need to "*enhance the flow of credit*" which had been hampered due to an impaired monetary policy transmission mechanism. Secondly, in 2009, the ECB had cut its main policy rate to 1 %, to historical lows at the time and even if there still was some room for manoeuvre in the conventional monetary policy framework, that room was exhausting i.e. the central bank was approaching the zero lower bound.

Moreover, as discussed in Chapter 1, when a severe pessimistic shock occurs, it can be necessary for a central bank to resort to other policy options than a rate cut.

Trichet (2009) recognizes five building blocks in the policy of enhanced credit support: 1) unlimited provision of liquidity in terms of fixed rate tenders with full allotment, 2) widening the framework for eligible collateral, 3) lengthening the maturities of the refinancing operations, 4) liquidity provision in foreign currencies, particularly in US dollars and 5) outright purchases of covered bonds. I will further discuss each of these items in the next section. In addition to the bunch of the measures that Trichet listed, the Securities Markets Programme (SMP) was launched in May 2010 to address the malfunctioning of securities markets and to restore an appropriate monetary policy transmission mechanism (ECB2010). In February 2013, when the program had already been ended, the ECB published the Eurosystem's holdings of securities acquired under the SMP and confirmed the market assumption that the government bonds of Ireland, Greece, Spain, Italy and Portugal had been purchased (ECB2013a). Simultaneously with the ending of the SMP program the ECB announced the technicalities of its newest monetary policy measure, Outright Monetary Transactions (ECB2012c) .Neither of these asset purchase programs has been explicitly categorized as enhanced credit support policy in the official ECB language. Nevertheless, as the liquidity effect of both of these asset purchase programs is fully sterilized, they can be classified as credit easing or enhanced credit support policies and not quantitative easing (Papadia & Välimäki, 2011: 230).To elaborate, these asset purchase programs are not targeted to overall easing of the monetary policy stance but instead they are targeted to improve the transmission mechanism.

3.2 ECB unconventional measures – enhancing monetary policy transmission

The rationale behind the unconventional monetary policy conducted by the ECB was discussed in the previous section. Before going to the details of the actual measures conducted by the ECB, it is useful to have a look at some basic principles behind the ECB rationale. First of all, according to Trichet (2012), unconventional measures are, first, fully independent from the conventional measures; second, entirely aimed at helping to restore a better transmission of the interest rate policy in times of abnormal functioning of financial markets and third, temporary by nature. Also Cour-Thimann and Winkler (2013, ss. 19-23) explain the principles underlying the ECB's unconventional response in comparison with the other major central banks. According to the them, the ECB has consistently phrased its unconventional actions in line with its monetary policy

strategy, which again applies a two-pillar assessment of risks to price stability (economic and monetary analysis). Secondly, the ECB has always communicated that the unconventional measures are a complement not a supplement for conventional monetary policy.

The next sections will explain the unconventional measures conducted by the ECB in further detail. Many of the measures listed below have been phased out and re-introduced in different phases of the crisis. The ECB crisis response has been a cocktail of measures including unlimited liquidity provision on a fixed rate against a wider set of eligible collateral, also in long maturities and foreign currencies, as well as outright asset purchases and forward guidance.

3.2.1 Fixed rate and full allotment procedure

During the financial crisis, the ECB changed its role in liquidity management from active to passive. Before the crisis, liquidity management served the role of achieving the operational target i.e. steering the short-term money market rate. When the financial crisis escalated, the increased credit and liquidity risks drove up the risk premiums in the euro area money market. As the increased tensions threatened to paralyze the whole market, the ECB had to step in and substitute the impaired private sector intermediation. (Papadia & Välimäki, 2011) Here, the introduction of the fixed rate full allotment procedure in liquidity-providing operations had a vital role. Even if liquidity provision with a fixed rate and full allotment procedure cannot be regarded as unconventional per se I consider it unconventional here since during the financial crisis this policy has had a key role in the ECB's crisis response[19]. More importantly, the full allotment procedure has lead to a significant balance sheet expansion.

A key concept in liquidity management is the one of neutral amount of liquidity in the banking system. According to Välimäki (1998), in a simplified framework, where the counterparties' demand for liquidity is solely determined by the reserve requirement, the neutral amount of liquidity equals the required daily balances for the remaining maintenance period[20]. In terms of the development of short-term money market rates, it is important whether the central bank allows the

[19] The ECB has also carried out fixed rate liquidity operations during 1999-2000 but at that time the operations were conducted with the proportional allotment procedure i.e. not all the bids were accepted in full. (Välimäki, 2001) In addition, although not discussed here, already in August 2007, the ECB conducted an overnight liquidity-providing operation with fixed rate and full allotment.

[20] Assumption is that the cost of the liquidity credit (in the ECB case, the marginal lending facility rate) is higher than the cost of holding excess reserves.

banking sector as a whole to take advantage of the reserves averaging provision or whether it attempts to steer the money market liquidity towards that neutral level. If the central bank always provides the counterparties with the neutral amount of liquidity, the banking system as a whole cannot exploit the averaging system. An individual bank could only hold excess reserves if another bank held reserves less than on average required. On the other hand, if the central bank allows the banks to determine the amount of liquidity that is provided and only sets the price for it, then the banking system as a whole can take advantage of the averaging provision. Should the banking system prefer to hold excess reserves as a whole they could. In that case, the banks would have more flexibility in terms of e.g. acquiring liquidity buffers.

Before the crisis, the Eurosystem liquidity management relied on the so called benchmark allotment calculation meaning that the ECB steered the liquidity conditions towards their neutral level. In the benchmark allotment calculation, before the announcement of each main refinancing tender operation, the ECB made calculations about the banking system's demand for required and excess reserves. The calculation took into account the liquidity already supplied during a given maintenance period, the accumulated excess reserves and the forecast of autonomous factors[21]. The benchmark allotment amount was the quantity of liquidity provided by the central bank with which the counterparties could smoothly fulfill their reserve requirements, satisfy their demand for excess reserves and maintain, ex ante and in aggregate terms, the same level of current account holdings on each day of the reserve maintenance period. Hence, the ECB actively steered the liquidity to its neutral level. This approach lead market participants to expect that on all but the last day of the maintenance period there was no need to make recourse to either of the standing facilities. Also, this lead to the overnight rate that was expected to prevail on the final day of the maintenance period being the average of the two rates on standing facilities assuming a symmetric interest rate corridor. (Papadia & Välimäki, 2011, s. 222)

In both Välimäki (1998) and (2001) it is assumed that the central bank policy rate i.e. the rate of the main liquidity-providing tender can change during the reserve maintenance period. Indeed, this was the case in the Eurosystem during the first years of its existence. It was not until 2004, that the

[21] Autonomous factors are items in the Eurosystem national central banks' balance sheets that are beyond the direct control of the ECB. These factors include government deposits, banknotes, foreign reserves, euro-denominated portfolios and other autonomous factors (Mercier, 2010). The net effect of autonomous factors on the banking system's liquidity position is liquidity-absorbing. In other words, autonomous factors add to the structural liquidity deficit of the banking system.

timing of reserve maintenance periods was modified to start on the settlement day of the main refinancing operation following a Governing Council meeting at which monetary policy decisions were taken (Papadia & Välimäki, 2011). Thus, in the current operational framework, market expectations on a rate cut or a rate hike do not play a role in banks' bidding behavior in a liquidity providing tender. In the previous case, expectations on a rate hike increased incentives for counterparties to demand more liquidity in a tender when they would expect the price of liquidity to go up during the same maintenance period. Furthermore, in a policy where a central bank would not accept all the bids in full but would instead scale back the bids to provide the banking system with neutral liquidity, the banks could practice heavy over-bidding[22].

Some of the conclusions made in Välimäki (2001) are also applicable to the current ECB framework even if there are no interest rate expectations that affect on the bidding behavior. According to Välimäki (2001), in a fixed rate full allotment environment, the banks were expected to front-load[23] reserves if a rate hike was expected and back-load them if a rate cut was expected. Another case where banks would similarly have the motive to front-load the reserves would be an increased uncertainty in the money market. Whenever there would be a lack of confidence among the banks in the money market or the banks would otherwise feel uncomfortable with their liquidity position (e.g. fears of deposit outflows), they would ensure to have fulfilled their reserve requirements at the central bank as early as possible. Thus, in a full allotment environment, the banks would again front-load reserves i.e. demand more liquidity early in the reserve maintenance period, and respectively, lower their demand when they had fulfilled or nearly fulfilled their reserve requirements. Furthermore, the banks could obtain precautionary liquidity buffers.

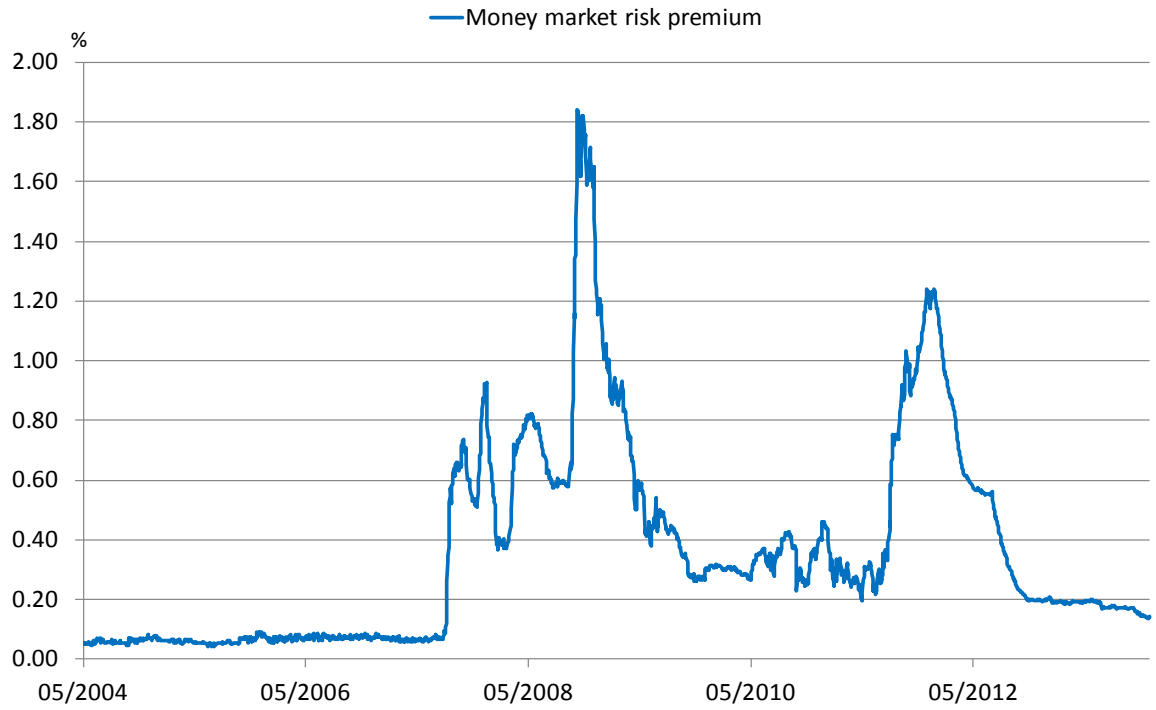
Indeed, as the financial crisis intensified, the benchmark allotment approach was no longer appropriate. Papadia and Välimäki (2011) explain the impairment of the international, deeply integrated and liquid money markets by the realization and intensification of credit risk and liquidity risk. The banks were reluctant to lend to each other not only because of the fear of not getting the money back (credit risk) but also because they feared that, if they lent money today, they

[22] Assuming the banks knew that the central bank was going to scale back the bids, they would put in over-sized bids since they would expect that the proportion of the allotment they would get would be small (Papadia & Välimäki, 2011, s. 218).

[23] In front-loading, the bank obtains liquidity from the central bank tender more than is needed to fulfill its average remaining reserve requirement. In averaging provision, this enables the bank to hold less than the average required reserves on its central bank account later in the same reserve maintenance period.

could be unable to borrow it back tomorrow (liquidity risk). The lack of confidence in the money market drove up the risk premiums which can be illustrated as the explosion of the spread between the rates of unsecured and collateralized lending (figure 4).

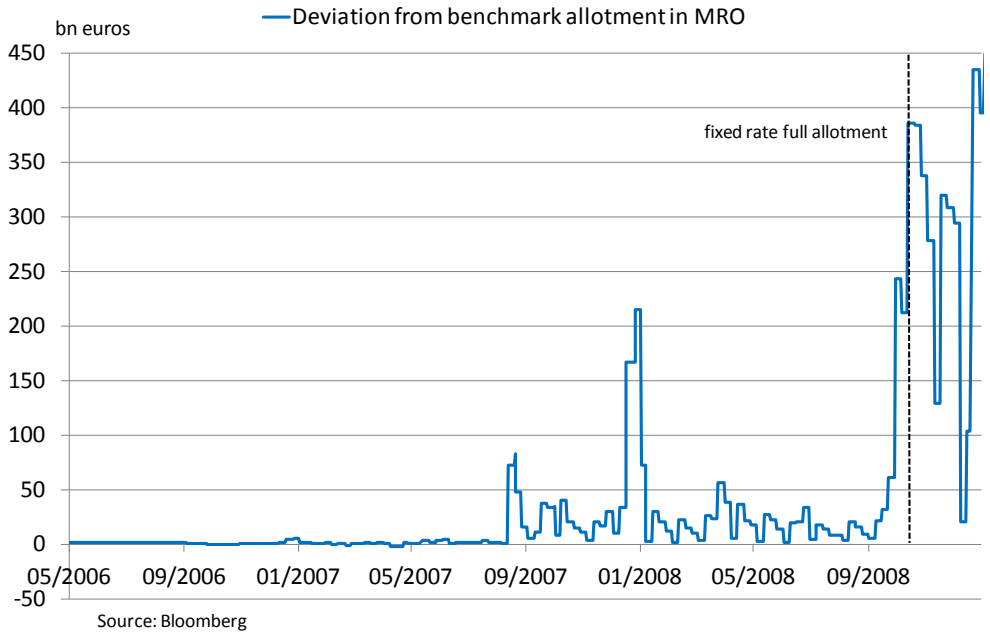
Figure 5 Lack of confidence among the banks heavily impaired the uncollateralized markets which drove up the risk premiums.



Source: Bloomberg, risk premium measured as the spread between 3M Euribor and 3M Eurepo rates

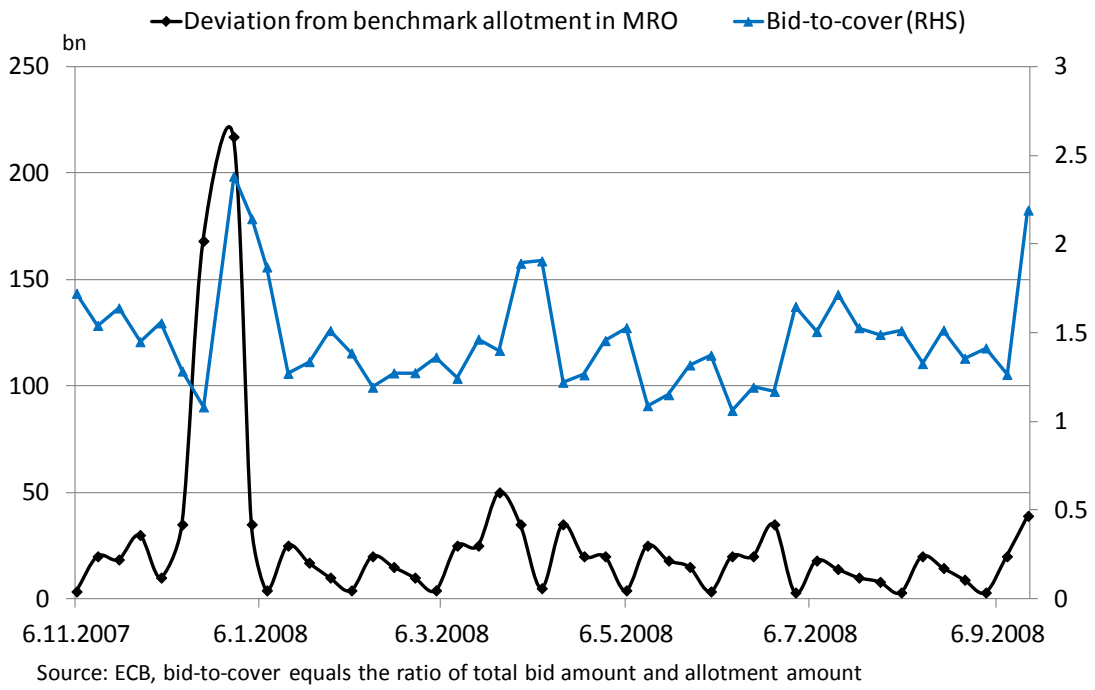
Another manifestation of the impairment of the money market was the increased dependence on central bank borrowing. As the counterparties were uncertain whether they could refinance themselves from the market they were willing to pay more for central bank refinancing. From August 2007 until October 2008, the average spread between the minimum bid rate in the main refinancing tender (the main policy rate) and the marginal rate, at which the last bid was accepted, was 16 basis points having risen from a mere few basis points to 45 basis points in October 2008. In the preceding year, before the crisis, the average spread had been 6 basis points. Simultaneously, the number of participants and the amount of bids also increased. The ECB responded to the higher demand of liquidity by banks at first by allotting more liquidity than would have been consistent with its benchmark allotment approach. In other words, the ECB provided the market with excess liquidity instead of steering liquidity to its neutral level. This development is shown in Figure 5.

Figure 6 ECB responded to banks' higher demand of liquidity by deviating from its benchmark allotment approach.



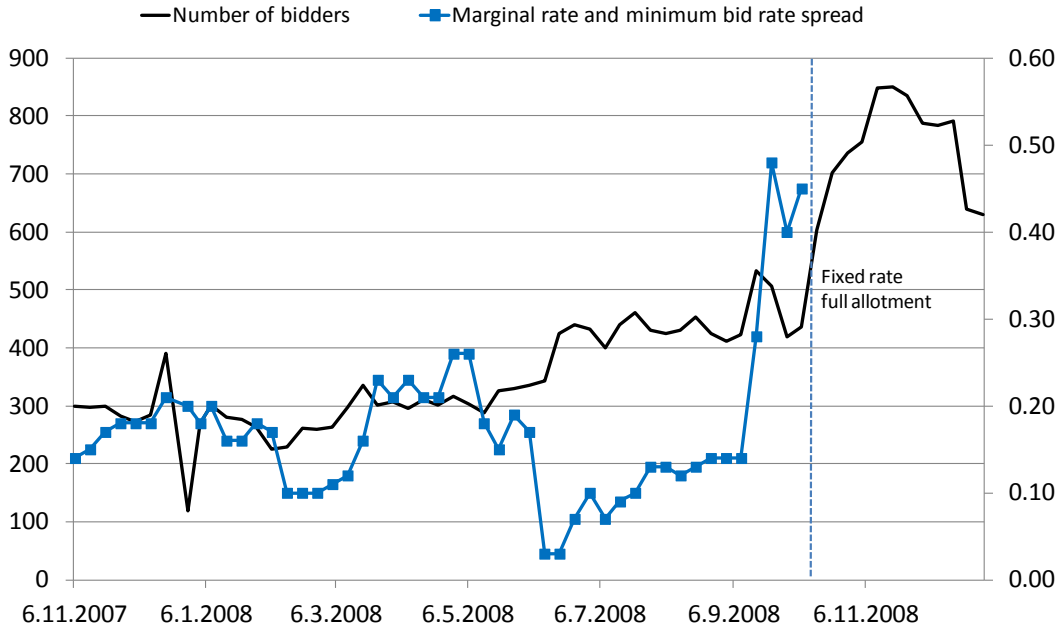
However, even if the ECB allotted more liquidity than was consistent with the benchmark allotment approach, a large amount of bids was still rejected. In September 2008, right after the bankruptcy of the Lehman Brothers, the amount of bids in the main refinancing tender increased by more than 100 billion euros to 329 billion euros. Eventhough the ECB deviated from the benchmark allotment, more than 170 billion worth of bids were rejected. Simultaneously, the number of bidders in tender had increased to more than 500 from an average of 300 during the late 2007 and early 2008. Also, the spread between marginal rate and the minimum bid rate had increased to more than 40 basis points. These developments are captured in Figures 6 and 7.

Figure 7 Changes in the banks' bidding behavior required EC B response.



Source: ECB, bid-to-cover equals the ratio of total bid amount and allotment amount

Figure 8 The number of bidders increased and the spread between the marginal rate and minimum bid rate went up.



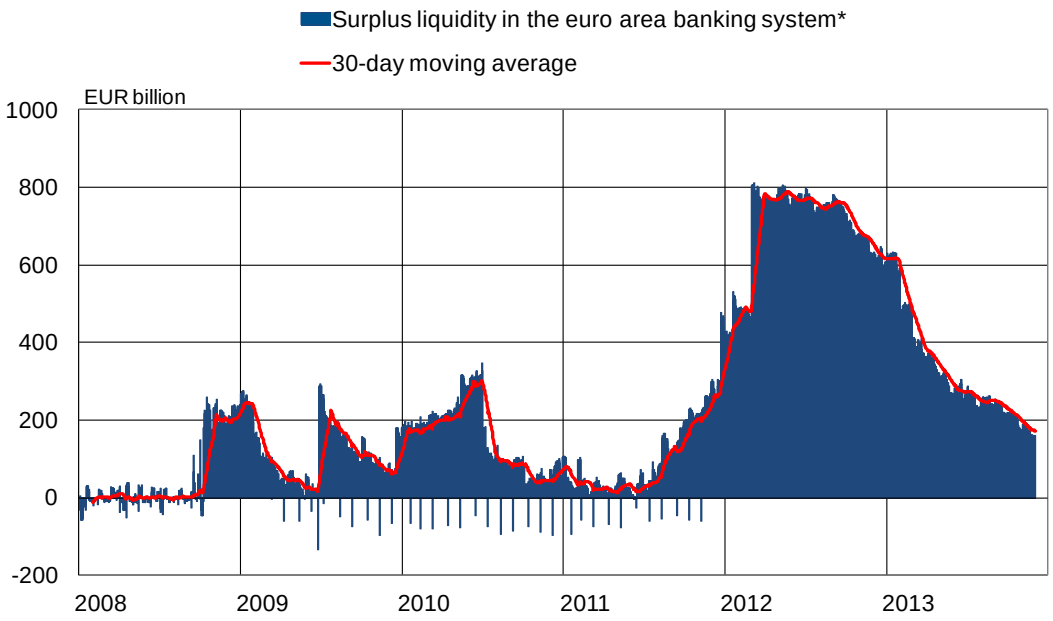
Source: ECB

To respond to the impaired private sector intermediation, high money market risk premiums and an increased demand by the banks for central bank liquidity, the ECB decided in October 2008 to carry out the weekly main refinancing operations through a fixed rate tender procedure with full allotment at the interest rate on the main refinancing operation (ECB2008c). A few days later the ECB further

enhanced the provision of liquidity when it announced that also the longer-term refinancing would be carried out as fixed rate tender procedures with full allotment (ECB2008d). The Governing Council has since then announced the fixed rate and full allotment policy to be continued at least until mid-2015.

The introduction of fixed rate full allotment procedure together with the extension of the maturities in refinancing operations led to an unprecedentedly high level of excess liquidity in the banking system as the banks craved for central bank liquidity. This development is captured in Figure 8, which shows the accumulation of excess liquidity in the euro area banking system. The next section will discuss the lengthening of the maturities in refinancing operations in greater detail.

Figure 9 Banks hoarded liquidity as the financial crisis intensified and the ECB changed its refinancing tender procedures.



Source: Bank of Finland.
Current accounts - reserve requirements + net use of standing facilities.

3.2.2 Extension of maturities in refinancing operations and emergency lending

During the crisis, the ECB has conducted several special-term refinancing operations with maturities from one month up to three years. Though refinancing operations, as such, belong to the conventional framework of the ECB monetary policy implementation, the significant extension of the maturities during the crisis made these measures unconventional. As explained in Sections 2.1.2 and 3.1.1, the ECB (via the national central banks) normally operates in maturities from one week

(main refinancing operation) to approximately three months. During the crisis, however, the ECB has offered refinancing for its counterparties in maturities up to three years. Before going in further detail to the special-term refinancing operations the ECB has conducted, it is useful to take a look at some reasons why central banks can and shall provide more liquidity to its banking sector during times of crises.

Bindseil and Jablecki (2013, pp. 8-9) recognize three reasons, why the central bank should act as the lender of last resort (i.e. accept higher risk and ensure sufficient liquidity provision) in a financial crisis. First of all, liquidity stress and defaults due to *illiquidity* have *negative social externalities*. A large-scale disorganized deleveraging in the banking sector due to liquidity problems can lead to fire sales, which in turn cause a wide-spread fall in asset prices. Fire sales are not the only negative externality. Other forms of externalities are the spreading of depositors' panic in the form of a bank run and a general drying up of funding and market liquidity in the financial system as a consequence of liquidity hoarding. These types of externalities can lead to a situation where many entities will find themselves temporary illiquid even though they are solvent. In other words, when the markets are functioning properly, liquidity problems of an institution reflect the investors' perception on actual solvency problems of that institution. This is contrary to a systemic liquidity crisis, where liquidity problems will correlate less with actual solvency issues.

Secondly, Bindseil and Jablecki (2013) outline that unlike other financial institutions the *central bank is not threatened by illiquidity* in its own currency because it has a monopoly to issue central bank money. Hence, it is natural that during times when all agents attach a high price to liquidity, the central bank remains more willing to hold assets which are less liquid (and more risky) and it will do so against a premium. Another related issue, according to Bindseil and Jablecki (2013), is that of bank and corporate defaults. Since defaults are always costly in themselves (assuming they destroy organizational capital), then central bank liquidity provision can save this capital. The saved capital can be regarded as part of the "rent" that is obtained through the co-operation of a liquidity-stressed agent and the one that has unlimited liquidity. The third motivation for a central bank to ensure sufficient liquidity provision is that the central bank can *mitigate the risks* associated to its liquidity provision efficiently *by applying haircuts on collateral*.

Cour-Thimann and Winkler (2013, s. 29) apply the concept of paradox of deleveraging in justifying the need for central bank intervention. The paradox means that an attempt by all sectors to

deleverage simultaneously by redeeming debt collides with the desire of sectors to keep accumulating financial assets, as one sector's debt is another sector's asset. This leads to fire sales that were discussed above. Attempts to deleverage by all sectors will thus lead to a self-defeating dynamics in aggregate, with leverage actually increasing as a result of lower asset prices. According to Cour-Thimann and Winkler (2013), the ECB liquidity provision has indirectly supported asset valuation and thus helped to avoid disorderly deleveraging and fire sales.

During the financial crisis, after the escalation of the sub-prime crisis in the US and before the revelation of the euro sovereign problems in spring 2010, the ECB responded to financial market tensions and liquidity stress several times by providing liquidity in maturities longer than the normal one week and three months. The first unconventional liquidity operations with maturities of three months were conducted in the autumn 2007. In March 2008, the ECB decided to conduct supplementary longer-term refinancing operations with a maturity of six months to support the normalization and the functioning of the euro money market. In addition, further supplementary three-month operations were provided (ECB2008a). After the Lehman collapse in September 2008, the ECB organized a supplementary operation with a maturity of one week (ECB2008b). In October 2008, the ECB decided to conduct its refinancing operations following full allotment fixed rate principle. In addition, they announced an enhancement of provision of longer-term refinancing; several operations with maturities of three and six months[24] (ECB2008d). In May 2009, the ECB again responded to the weakness of the economy by announcing three refinancing operations with maturities of one year (ECB2009a).

In 2010-2011, the epicenter of the crisis had shifted from the US to the solvency fears of some euro area sovereigns. The ECB had first tackled the financial market tensions in May 2010 by launching the Securities Markets Programme which is further discussed in Section 3.2.5. The risk premiums in the euro area money market exploded due to increased uncertainty and lack of confidence in the banking sector (some banks had large exposures on particular sovereigns). Fears of sovereign default in Greece, Portugal and even Ireland pushed some euro area government bond yields to unprecedented levels. Dread of contagion lead to massive sales also in the sovereign debt market of Italy and Spain. The ECB monetary policy transmission mechanism was impaired. The provision of

[24] All refinancing operations from October 2008 onwards were organized with full allotment and fixed rate where the rate is indexed to the average main refinancing rate.

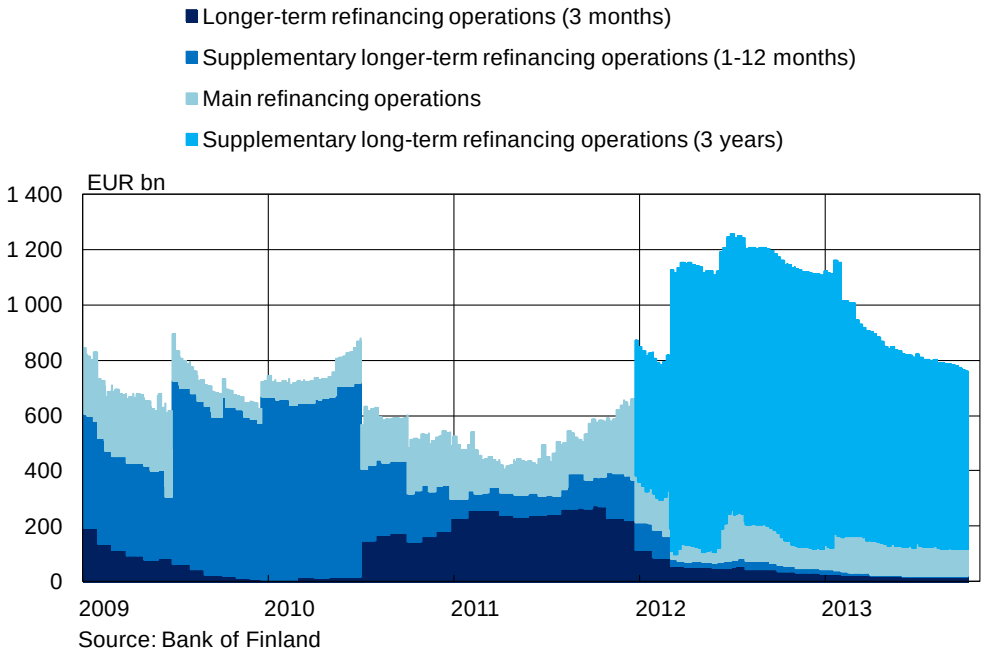
credit and the loan rates for retail and corporate customers in the stressed countries primarily reflected the tensions in the domestic bond market instead of reflecting the desired monetary policy stance of the ECB or the credit risk related to the borrower.

Accordingly, in August 2011, citing the renewed tensions in some financial markets in the euro area, the ECB announced a supplementary liquidity operation with a maturity of six months (ECB2011a). In addition, two months later, the ECB announced two refinancing operations with maturities of approximately one year (ECB2011c). However, in December 2011, this announcement was partially reversed as the ECB announced two refinancing operations with a maturity of three years. These operations replaced the announcement on the second one-year LTRO. In addition, the banks that had participated on the first one-year LTRO were provided with the opportunity to shift from the one-year-LTRO to the three-year LTRO. The novelties of three-year-LTROs were the exceptional maturity of the operation and the option of early repayment after one year (ECB2011e).

The first 3-year LTRO was conducted in December 2011 with a maturity of 1134 days. The total bid amount climbed up to more than 489 billion euros with 523 Eurosystem counterparties taking part. (ECB, Open market operations, 2011) In the second 3-year operation, a total of 529 billion euros was allotted to as high a number as 800 counterparties. According to ECB president Draghi (ECB2012a), the number of participants indeed was the major difference between the two very long-term operations (VLTROs). Draghi elaborated at the time that the increased participation in the latter VLTRO (e.g. more than 400 German banks) meant that the money would flow to the small and medium-sized enterprises (SMEs) which, in turn, are in charge of 80 % of the employment in the euro area. The market effects of these VLTRO announcements and allotments as well as the first repayment options are examined in Chapters 4 and 5. Figure 9 illustrates the evolution of the ECB liquidity providing operations during the crisis.

The effectiveness of liquidity provision has been debated. Taylor and Williams (2009) study the effects of Federal Reserve's Term Auction Facility (TAF), a somewhat similar liquidity-providing facility than those of the ECB's and find no empirical evidence that the TAF had reduced money market spreads. They conclude that increased counterparty risk between banks contributed to the rise in spreads, so it is only logical that the central bank efforts were not that effective since they can only reduce the liquidity risk.

Figure 10 Three-year loans make the largest part of the banking system liquidity in the euro area.



3.2.3 Changes in eligible collateral and risk control framework

It is generally acknowledged that in a financial crisis, central banks ought to be the lenders of last resort. As the monopolist supplier of liquidity, central bank has the key role in mitigating liquidity crises. Issues related to the ECB's liquidity management during the crisis were discussed in previous sections. With respect to the ECB's role as the lender of last resort, however, of equal importance, are the changes in the ECB's eligible collateral framework. This section discusses the key considerations in central bank collateral and risk management, the role of these frameworks in a financial crisis and the major changes that have been applied in the Eurosystem framework during the crisis.

A key concept in understanding why the central banks actively need to evaluate their risk management and collateral framework is the one of collateral scarcity (Bindseil, 2011). One can understand collateral scarcity by thinking about a scenario where collateral would not be scarce. This would be possible if the central banks had perfect collateral analysis and management technology i.e. they could make precise and correct valuations on different assets. However, as perfect asset valuation is often impossible and as there is a fundamental profit and loss asymmetry, a central bank needs to impose a haircut on the value of the collateral to achieve zero expected losses in case of a counterparty default.

According to Bindseil (2011), another case, where collateral would not be scarce, would be a case of uncollateralized central bank lending. However, there are several reasons why the central banks should not practice uncollateralized lending. First, the management of credit risk is not a central bank's expertise. Second, uncollateralized lending would contradict with the central bank's public accountability. Third, as active liquidity management requires an ability to act quickly, uncollateralized lending would not be rational as the process of evaluating the credit risk is time-consuming. Fourth, a central bank, especially in the ECB case, operates with a wide range of counterparties some of whom can have low credit rating. A central bank establishing credit lines that reflect the creditworthiness of different bank would result in a self-fulfilling process of where a deterioration of counterparty's credit quality would also result in its inability to borrow from the market. Thus, as the hypothetical scenarios of perfect asset valuation and uncollateralized lending have to be rejected the author concludes that collateral will be scarce and that the central bank has a great power in affecting collateral availability for the counterparties.

In a financial crisis, the issue of collateral scarcity becomes even more important and the central bank may need to be more flexible with regard to the desirable properties on eligible collateral. According to Bindseil and Jablecki (2013), the central bank needs to balance between its own risk-taking and a smooth implementation of monetary policy, but also, it needs to evaluate a trade-off between i) the potential costs of defaults of viable but illiquid banks and ii) the potential costs of preservation of insolvent banks. The authors identify three characteristics or risks of central bank lending in a crisis that undermine the importance of collateral and risk management. Firstly, during a crisis, probabilities of default of central bank counterparties and issuers of debt instruments used as collateral increase. In other words, there is an increased risk there is a counterparty that fails to pay back the loan it has received from the central bank against eligible collateral, and also, the issuer of the collateral has defaulted. Secondly, during a crisis, the central bank lending tends to shift towards stressed counterparties as those are typically the ones that lose market access and experience funding gaps. Thus, the asset side of a central bank becomes, on average, more risky and less diversified. Thirdly, the central bank balance sheet lengthens, either because the central bank takes the role of intermediary in the financial system (increased central bank lending), or because the households turn their deposits into cash.

Bindseil and Jablecki (2013) construct a model for an optimum level of haircuts on collateral that minimizes social or central bank expected losses. The model assumes that relevant interbank

markets are impaired and capital market access and deposit flows are uncertain and volatile. It seeks to address the key trade-offs and the optimal central bank policies from a risk management and social welfare perspective, namely, the costs of i) letting illiquid but solvent institutions go bust or ii) promoting moral hazard and preserving loss-making businesses by elastic liquidity-provision. The model shows that central bank risk-taking and social welfare are in many cases non-monotonous functions of haircuts, and even if monotonous, they can be either upward- or downward sloping. Furthermore, it shows that whereas increasing haircuts can either increase or decrease central bank risk-taking, and either increase or decrease social welfare, also, the social welfare losses easily outweigh central bank losses. A key result is that, in stressed market conditions (especially in a systemic crisis), high negative externalities of default and de-correlation of liquidity shocks with solvency, central bank risk-taking can indeed increase with the level of haircuts. In other words, a looser collateral framework is consistent with protecting the central bank's balance sheet from losses. The implication is that, during a financial crisis, when costs of default increase and liquidity shocks become more random, the central bank should increase the total post-haircut amount of collateral relative to the size of the balance sheet.

The changes in the Eurosystem collateral framework during the crisis have been discussed in a Monthly Bulletin article (ECB, 2013). In the first phase of the financial crisis, in 2008, the ECB, together with the introduction of the fixed rate and full allotment procedure and a step-up in the provision of term-liquidity in US dollars, decided to temporarily expand the list of eligible collateral. Firstly, the credit threshold for marketable and non-marketable assets was lowered from A- to BBB- together with a flat haircut add-on. An exception was made with regard to asset-backed securities (ABSs), for which the minimum threshold of A- remained in force. Simultaneously, the Eurosystem started to accept as collateral debt instruments that were issued by credit institutions which were traded on certain non-regulated markets deemed acceptable by the ECB. Also subordinated marketable debt instruments with certain provisions, as well as fixed-term deposits held with the Eurosystem, also became eligible. Later on, the ECB accepted marketable debt instruments issued and denominated in certain foreign currencies with certain provisions. With regard to all of the above changes in the eligible collateral framework, the ECB applied specific risk control measures such as valuation mark-downs. Later on, some of the above measures became

permanent whereas some of them were exhausted in 2011[25]. However, as the period of calm was short-lived, many of the exhausted measures were reintroduced soon. (ECB, 2013)

In the second phase of the crisis, as the epicenter of the market turbulence had shifted in the euro area, the ECB made significant measures regarding the sovereigns under market pressure. The Governing Council of the ECB decided to suspend the minimum requirements for credit quality thresholds for certain marketable instruments issued or fully guaranteed by the central governments of the euro area member states under an EU/IMF program. Not making this exception would have been catastrophic for banks holding masses of sovereign debt issued by these countries since they would not have been able to obtain central bank refinancing at the time they were also meeting a very challenging market refinancing environment. Thus, the Eurosystem not making an exception would have further accelerated the distress that the banks under these stressed sovereigns were already experiencing.

The third phase of the crisis, the escalation of the tensions in the euro-area sovereign debt market in 2011, led the ECB to announce additional enhanced credit support measures. In late 2011, the Governing Council decided to increase collateral availability by i) reducing the rating threshold for certain asset-backed securities (ABSs); and ii) allowing NCBs, as a temporary solution to accept as collateral additional performing credit claims (ACCs i.e. bank loans) that satisfy specific eligibility criteria (ECB, 2013). Furthermore, in 2012, the rating threshold for ABSs was further reduced in order to support the provision of credit to households and businesses. The temporary measures of accepting marketable debt instruments denominated in foreign currencies were reintroduced.

Changes in the Eurosystem collateral framework resulted in an increase of total nominal value outstanding of eligible marketable assets of 46 %, to almost 14 trillion euros, between the onset of financial crisis in 2007 and the end of 2012[26] (ECB, 2013). The share of central and regional government bonds has traditionally been the highest and after expanding in 2007-2010 it has stayed relatively stable at roughly 40 %. With regard to uncovered bank bonds, the average volume and

[25] In April 2010, the Governing Council decided to keep the minimum credit rating quality threshold at the investment level, i.e. BBB- (or equivalent). Thus, the temporary measure became a permanent principle. Also, the ECB published a schedule of graduated valuation haircuts to the assets rated in the BBB+ to BBB- range which replaced the previous flat haircut add-on. Fixed-term deposits were permanently added to the list of eligible assets as of 1 January 2011.
[26] The volume of potentially eligible non-marketable assets is harder to evaluate since they only become known to the Eurosystem upon submission as collateral.

share of eligible assets reflects the ECB's decisions; in 2008, to accept bonds listed on certain non-regulated market, to discontinue this decision in 2011, and again to re-implement it in 2012 on a permanent basis[27]. With respect to ABSs and corporate bonds, their volume almost doubled between 2007 and 2010. Despite the market impairments, the issuances increased much owing to the fact that the originator of an ABS is allowed, under certain conditions, to use the issued security as collateral. However, the risk control measures implemented in the Eurosystem between 2009 and 2011 are mirrored in the reduced average volume of eligible ABSs. For covered bonds, the volumes have also reflected Eurosystem policy measures, especially with respect to the Covered Bond Purchase Programs (CBPPs). The first CBPP led to increasing numbers of euro area countries to adopt regulations underlying covered bond issuances which made many new issuances eligible for Eurosystem operations. Also, retained deals became more common as also covered bonds can be, under certain conditions, submitted as collateral by their issuer and banks often considered them a good alternative to ABSs because of the lower haircuts. Thus, covered bonds still represent the third largest asset class in terms of eligible collateral even though the issuance has been muted in the crisis years.

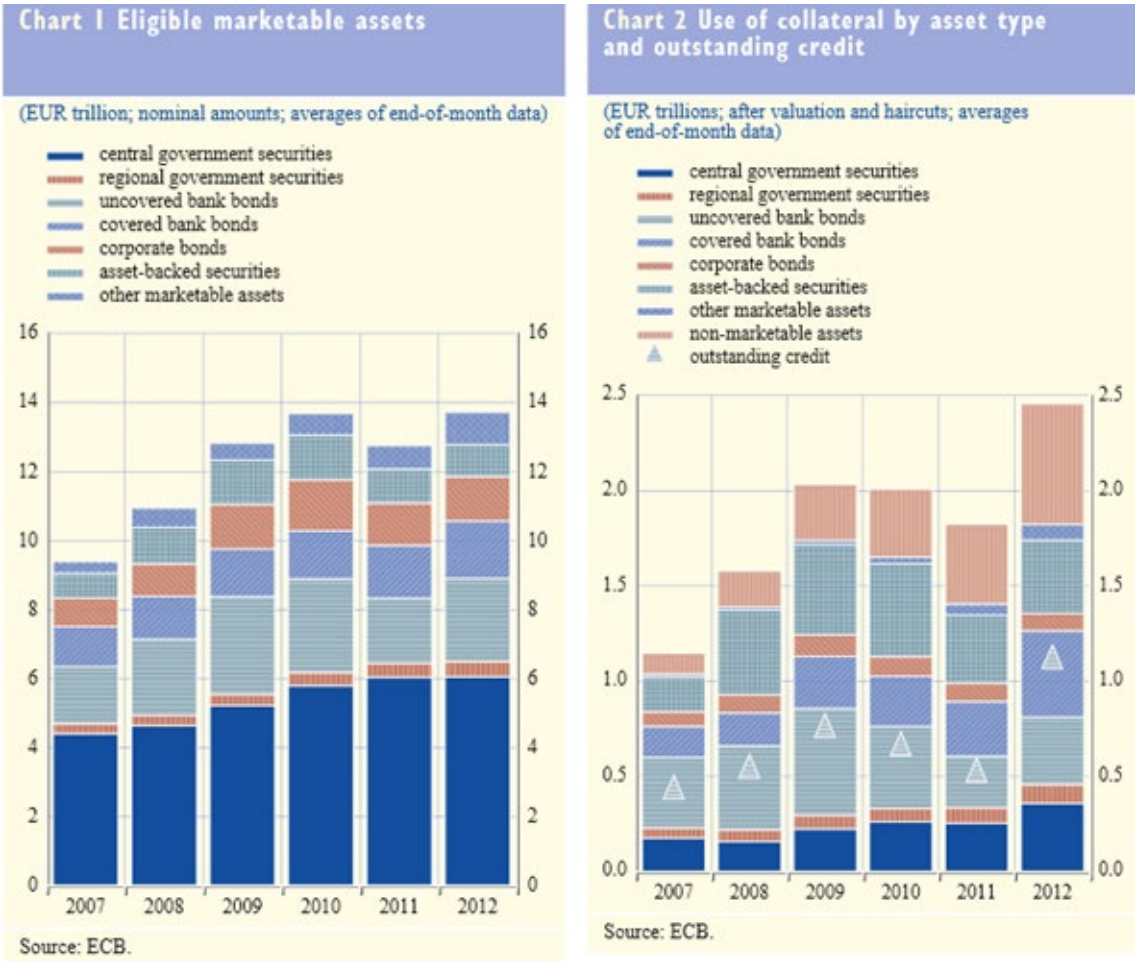
In relative terms, the volume of submitted collateral has risen even more than the volume of eligible collateral. The increased use of collateral is a direct consequence of other unconventional measures, specifically, of increased liquidity provision by the Eurosystem. Corresponding to the findings of Bindseil and Jablecki (2013), as a result of the ECB crisis measures, the total amount of collateral posted by Eurosystem counterparties, after valuation and the application of haircuts, increased from 1,1 trillion in 2007 to almost 2,5 trillion in 2012. As with the composition of the eligible collateral, also the composition of the used collateral has changed significantly. The sovereign rating downgrades and falling bond prices resulted in a reduction of the collateral base for the private repo and interbank markets, which led to an increase in the use of central and regional government bonds. Their volume doubled in 2007-2012. However, as the overall volume increased similarly, the share of government bonds on the used collateral actually remained relatively stable.

The value of uncovered bank bonds has been volatile but, in the end, their volume has decreased. The decrease of the volume of uncovered bank bonds probably results from the ECB's risk control

[27] Furthermore, the developments in the uncovered bank bonds market were affected by schemes of some euro area governments to guarantee securities issued by credit institutions in order to support their banking systems. These bonds became eligible in late 2008 and most of them matured with the expiry of state guarantees during the course of 2010.

measures that limit the use of uncovered bank bonds. Both the use of covered bonds and ABSs increased significantly whereas the use of corporate bonds and other marketable assets remained relatively stable. The use of non-marketable assets increased steadily encompassing not only credit claims under the standard framework and those under the ACC framework but also fixed-term deposits held within the Eurosystem and became, in relative terms, the largest lot. In terms of the relative weightings, the share of covered bonds and corporate bonds remained stable. Conversely, the share of uncovered bank bonds more than halved and the share of non-marketable assets jumped. The share of ABSs has also fluctuated. (ECB, 2013) Figure 10 summarizes the developments in the composition of the eligible marketable assets as well as the developments in the composition of collateral usage.

Figure 11 Outstanding amount of eligible marketable assets has increased 46 % in 2007-2012 mainly due to the changes in the Eurosystem's collateral framework and eligibility criteria. Use of collateral has increased even more also reflecting the expansion in the ECB's liquidity provision. (Source: ECB, The Eurosystem Collateral Framework Throughout the Crisis, 2013)



Even if the total post-haircut amount of collateral has increased in the Euroystem during the crisis, the average haircut has also increased. According to the ECB (2013), this development mainly reflects the changes in the eligibility criteria which have allowed counterparties to increase the use of collateral with higher risk profile and, thus, with higher haircuts. Due to the introduction of the temporary measures at the onset of the crisis, which led to higher submission of riskier assets as collateral, the weighted average haircut increased by around 3,6 percentage points to 9,2 % in 2009 compared to pre-crisis times. Subsequently, several measures by the Eurosystem have led to a further increase in the weighted average haircut to 14 % in early 2013. The increase in average haircut not only reflects the increased use of riskier assets as collateral (with higher haircuts) but also the risk control measures implemented by the Eurosystem. However, the ECB estimates that changes in the counterparties' behavior (usage of collateral) have contributed more to the rise in average haircut than the ECB's risk control measures.

During the crisis, the ECB has introduced several changes in its risk control framework not only to protect its balance sheet from risks but also to respond to general changes in the financial markets and also lessons learned during the financial crisis. The ECB evaluates its risk control framework biannually and some of the major changes like adjustments on haircuts and limits on the use of uncovered bank bonds were already discussed above. In addition, in 2010, the Eurosystem launched a project to establish loan-level information requirements for potential application in respect of ABSs in its collateral framework. This initiative aimed at increasing market transparency of these securities, therefore, also contributing to better informed risk assessments and helping to restore confidence in the ABS market. Also, in 2013, the Governing Council decided to prevent the use as collateral of uncovered government-guaranteed bank bonds that have been issued by the counterparty itself or an entity closely linked to it, as well as covered bonds with such bank bonds in their pool. The decision will come into force in 2015. (ECB, 2013)

3.2.4 Liquidity provision in foreign currencies

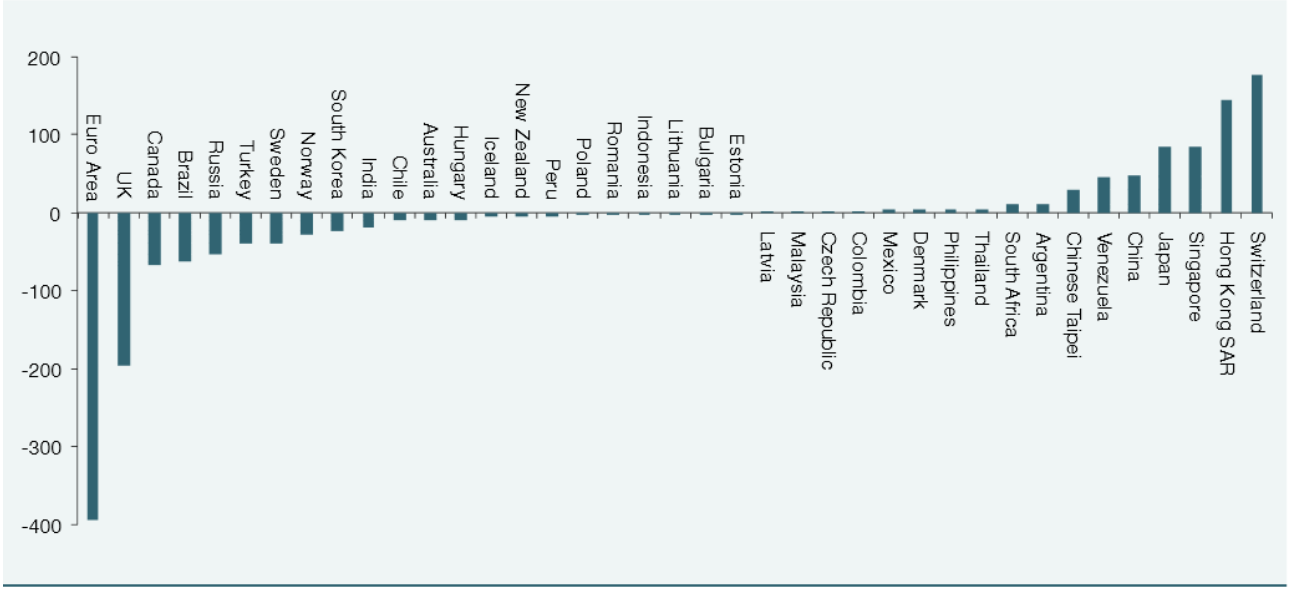
The previous three sections discussed issues related to the ECB's euro-denominated liquidity provision. It was outlined how the ECB, during the crisis, changed its operating procedures by introducing the fixed rate and full allotment policy and extending the maturities in its liquidity-providing operations. Furthermore, it was presented how the ECB also affected the availability of eligible collateral in its credit operations. All these measures addressed and alleviated the mounting

funding pressures that the banks were facing as the interbank market was not functioning normally. However, during the crisis, banks in the euro area also faced severe challenges in funding denominated in foreign currencies, especially in the US dollar. As the interbank market froze, the globally integrated banking sector suffered from liquidity shortages of several currencies that were trading in the foreign exchange market. To address these difficulties, the major central banks established swap lines to ensure the availability of their home currency outside their home country. It has even been said that the central bank swap lines are one of the most notable examples of central bank cooperation in history (Obstfeld;Shambaugh;& Taylor, 2009). This section outlines the reasons for the establishment of the swap lines between the major central banks, presents some evaluations on their effectiveness and explains the measures that were targeted to alleviate pressures in the euro area banking system.

Moessner & Allen (2012) explain the motivation behind the central bank swap arrangements by measuring currency-specific liquidity shortages for several major currencies such as the US dollar or the euro. They evaluate the currency-specific liquidity shortage in any country by subtracting the total funds in a specific currency that banks can raise from different sources (including central banks) and total illiquid liabilities in that currency from the banks' total liabilities in that specific currency. Since the data, however, is not available in official resources, the authors use net outstanding foreign currency claims on BIS reporting banks as a proxy for currency-specific liquidity shortage. Their review shows that, in the euro area, there was a severe shortage of US dollars and Swiss francs. In a comparison of liquidity shortages of five currencies (the US dollar, the euro, the yen, the pound sterling and the Swiss franc) in 39 countries (or currency unions) the shortage of US dollars in the euro area was the largest one. The shortage of Swiss francs in the euro area was the fourth on the list[28]. Figure 11 shows that the net outstanding amount of US dollar cross-border claims in the euro area was close to 400 billion US dollars.

[28] The second largest currency-specific shortage was the shortage of yen in the United Kingdom and the third largest shortage was the one of euros in the United States.

Figure 12 Net outstanding U.S. dollar cross-border claims on BIS reporting banks by economies shown (in billions of US dollars as of December 2008) Source: Moessner R. & Allen A.W., 2012



The massive foreign currency exposures were due to many banks giving loans in foreign currencies, especially those currencies in which interest rates had been relatively low. They had refinanced the loans by taking deposits in the currency of the loan in the interbank market or by taking deposits in their home currencies and using foreign exchange swap markets to eliminate foreign exchange risk. (Moessner & Allen, 2012) In other words, the maturities of banks' foreign currency assets often did not match with their liabilities as they were giving out loans in long maturities but funding themselves in short maturities in the interbank market. This maturity mismatch became a problem when the deeply integrated global interbank market was paralyzed by the lack of confidence when the crisis hit. The banks were reluctant to lend to each other and also the foreign currency swap market dried out.

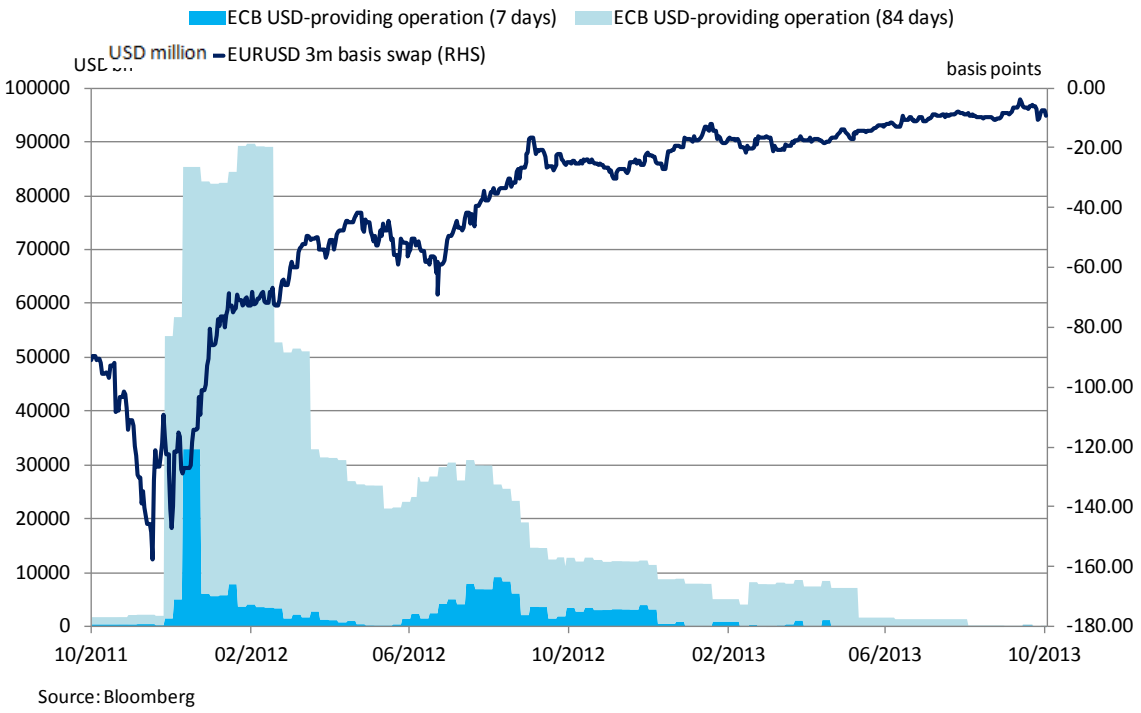
In the euro area, the first measures were taken in late 2007 after the tensions in the money market had risen due to the US subprime crisis. In December 2007, five major central banks, the Bank of Canada, the Bank of England, the ECB, the Federal Reserve and the Swiss National Bank announced joint measures to address elevated pressures in the short-term funding markets. The Eurosystem announced that it would conduct US-dollar liquidity providing operations in connection with the Term Auction Facility, which was the Federal Reserve's lending facility for its counterparties in the US. Once the swap lines were set, the Eurosystem counterparties could obtain

dollar-liquidity from the ECB against Eurosystem-eligible collateral. The tenders were carried out by applying the fixed rate full allotment procedure.

During the crisis, the Eurosystem has also conducted USD and CHF swaps against the EUR with its counterparties, in which no collateral was posted as there were only interest rate flows and no exchange of principal. USD-liquidity providing facilities were the most heavily used. The facility was suspended in January 2010 when the USD-funding pressures had abated but re-launched already in May 2010, when the European sovereign debt crisis ignited and fears of systemic funding crisis re-emerged in the money market. Figure 12 shows how the ECB responded to tensions in the foreign currency swap market. The EURUSD 3-month basis swap illustrates the cost of swapping euro for dollars.

In 2013, the ECB announced it had established standing swap arrangements with the above mentioned four central banks and the Bank of Japan. The standing arrangements meant that liquidity providing operations in any of these foreign currencies could be carried out anytime should the occasion emerge. In addition to the standing arrangements, the ECB has established swap line agreements with several other central banks. For example, in October 2013, the ECB established a three-year bilateral currency swap agreement with the People’s Bank of China for a maximum value of 350 billion Chinese yuan and 45 billion euro.

Figure 13 The ECB responded to the rising costs of dollar funding by conducting liquidity operations in USD.



Source: Bloomberg

The effectiveness of central bank swap lines has been evaluated from different viewpoints in several studies. Rose and Spiegel (2012) have examined the overall benefits of central bank swap lines and find robust evidence that dollar-denominated liquidity provision disproportionately benefited countries that were more exposed to the United States through either trade or asset exposure. Baba and Shim (2010) have compared the effectiveness of dollar-denominated liquidity provision by Bank of Korea funded with foreign reserves versus liquidity provision that was funded with the swap line with Federal Reserve. Their conclusion is that the swap line was more effective than the use of foreign reserves. Moessner and Allen (2013) have studied the effectiveness of the ECB's swap line with the Federal Reserve at the onset of the euro area sovereign debt crisis (2010-2011) and find that, whereas the announcements of the swap line had significant effects in reducing euro-dollar FX swap spreads, the swap line, per se, had only limited effectiveness, probably owing to stigma being attached to its use.

3.2.5 Asset purchase programs

During the crisis, the ECB alongside other major central banks has conducted outright asset purchases in the market. The purchases have targeted the malfunctioning of the monetary transmission mechanism through a support on bank lending. Indeed, the ECB has conducted two

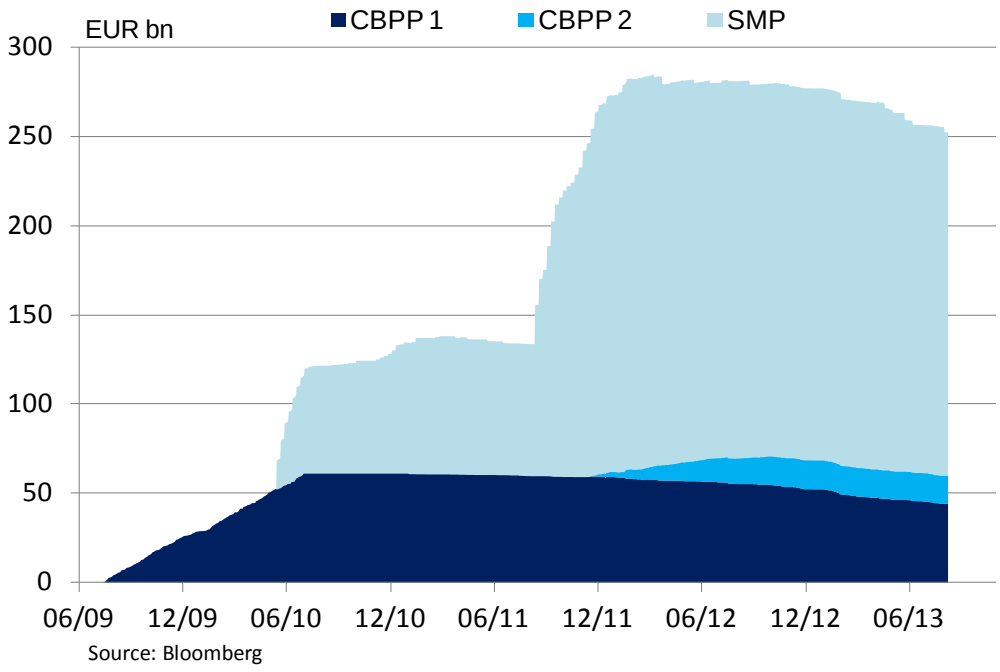
separate covered bond purchase programs and a Securities Markets Program (SMP) that was originally communicated to target public and private debt securities markets in those segments which were dysfunctional (ECB2010). Later on, it was published that the SMP had contained purchases of government bonds. The portfolio consisted of bonds issued by the governments of Ireland, Greece, Spain, Italy and Portugal (ECB2013a). In addition to the above mentioned programs, in 2012, the ECB announced its preparedness of conducting outright monetary transactions (OMT) i.e. purchases in sovereign bond markets with strict conditionality and an aim of safeguarding appropriate monetary policy transmission and the singleness of the monetary policy (ECB2012c).

The first covered bond purchase program (CBPP1) was launched in June 2009. The target size of the program was 60 billion euro and the direct purchases were distributed across the euro area and conducted in both primary and the secondary markets. To be eligible for the program, the covered bond had to be eligible for use as collateral for Eurosystem tender operations. It had to comply with certain criteria defined in the 1988 Directive on Undertakings for Collective Investments in Transferable Securities (UCITS). The issue volume of the covered bond had to be, as a rule, no lower than 500 million euro and, in any case, not lower than 100 million. The minimum rating requirement was, as a rule, AA or equivalent by at least one of the major rating agencies (Fitch, Moody's, S&P or DBRS). In any case, the absolute minimum rating requirement was BBB-/Baa3. The covered bond had to have underlying assets that included exposure to private and/or public sector entities. All the counterparties that were eligible for the Eurosystem credit operations were also eligible for the program. In addition, also those euro area-based counterparties that the Eurosystem used for the investment of its euro denominated portfolios were eligible for the program (ECB2009c).

The second covered bond purchase program (CBPP2) with a target amount of 40 bn euro was launched in October 2011. The technical modalities in CBPP2 were mostly similar to CBPP1. However, in CBPP2 the minimum requirement for issue volume was 300 million and the minimum rating requirement was BBB- or equivalent. The maximum residual maturity for eligible covered bonds was 10.5 years. In CBPP2, any counterparties that were used by the Eurosystem for the euro-denominated investment portfolios were eligible for the program, whereas in CBPP 1, only euro area-based counterparties had been eligible (ECB2011d).

According to the ECB final report on CBPP1 (ECB, 2010), the purchases reached the targeted amount of 60 billion in June 2010. In total, the Eurosystem bought 422 securities, 27 % in the primary market and the remaining 73 % in the secondary market. The average modified duration of the bonds was 4.12 years with the purchases mainly concentrating on maturities of three to seven years. The CBPP2 never reached its target amount in purchases and the program was ended in October 2012. The ECB never reached the intended amount in purchases because there was both an increase in investors' demand for euro area covered bonds as well as a simultaneous decline in the supply of covered bonds (ECB2012f). Both factors can at least partially be understood in the light of the decreased tensions in the financial market and the improvements in banks' financial positions due to the three-year LTROs that were discussed in the previous section. Obviously, the banks did not urgently need market financing because they had already refinanced themselves for three years at the ECB. The improved financial position, in turn, increased investors' confidence in the banking sector which could have led to higher demand. Thus, in CBPP2, the ECB only purchased 16.42 billion euro worth of covered bonds. All of the covered bonds purchased under the programs are intended to be held until maturity. Figure 13 shows the accumulation of the covered bond purchases as well as the purchases under the Securities Markets Program which is discussed next.

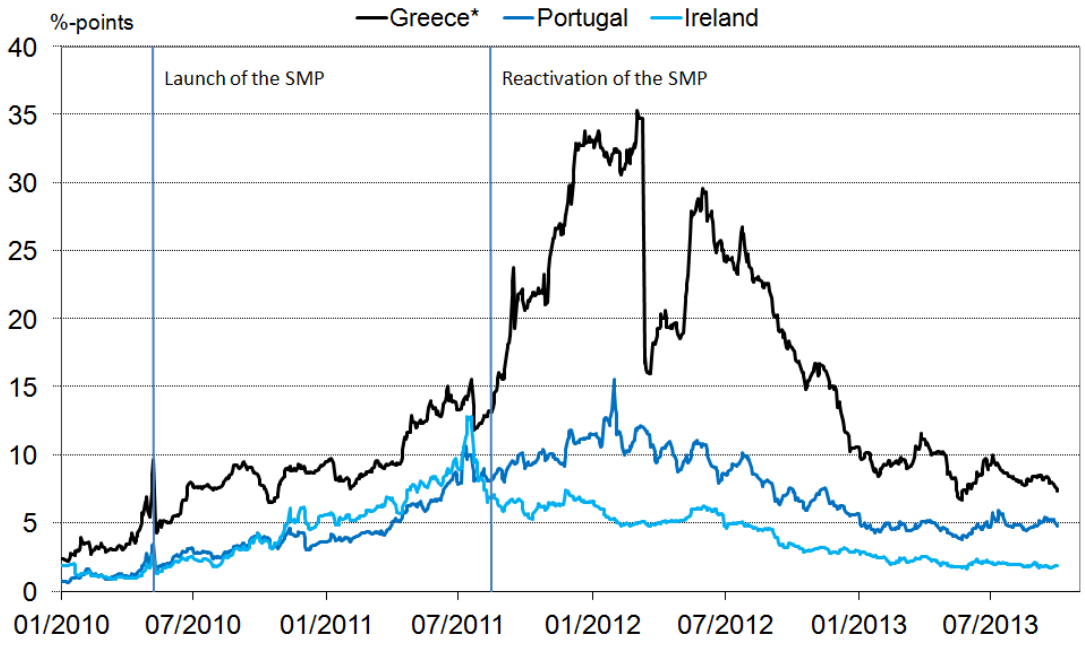
Figure 14 ECB has purchased covered bonds and government securities to support the monetary policy transmission. The portfolio is gradually decreasing as the securities mature.



In the spring 2010, fears of sovereign default in Greece escalated. The tensions and the mistrust repelled investors from the Greek sovereign bond market. In the beginning of May 2010, euro countries and the International Monetary Fund agreed on a bailout package of 110 billion to salvage Greece from defaulting on its debt. From January to the beginning of May 2010, the Greek 10y bond yield jumped from 5.7 % to higher than 12 %. The risk premium on Greek sovereign bonds measured as the yield spread to Germany was almost 10 %-points. More worryingly, there was a risk of contagion. Some other euro area countries were also struggling with their ability to maintain the investors' confidence. Ireland was facing problems with its banking sector due to the financial crisis. Portugal and other southern European countries not only had challenges with their public finances as the global recession deepened but they also had large exposures to the Greek debt. The rating agencies reacted to the deteriorating positions of the sovereigns and cut the ratings multiple times. In response, the risk premiums for Irish and Portuguese sovereign bonds also rose sharply and the situation prompted the ECB to respond (Figure 14).

The press release from May 2010 included an unprecedented item about conducting interventions in the euro area public and private debt securities markets to ensure depth and liquidity in dysfunctional market segments (ECB2010). The justification for the intervention was that the tensions in the financial markets were hampering the monetary policy transmission mechanism and were thereby threatening the objective of price stability in the medium-term. The objective of the program was to address the malfunctioning of securities markets and to restore an appropriate monetary policy transmission mechanism. The ECB wanted to ensure that its monetary policy stance was not affected due to the purchases in the Securities Markets Program (SMP) and, thus, announced that it would conduct specific operations to re-absorb the liquidity injected through the SMP purchases. As already mentioned, the ECB did not initially give any precise information about the purchases with regard to the market segments to which they were targeted. However, it was revealed later on that the purchases had targeted Greek, Irish, Portuguese, Spanish and Italian sovereign bonds.

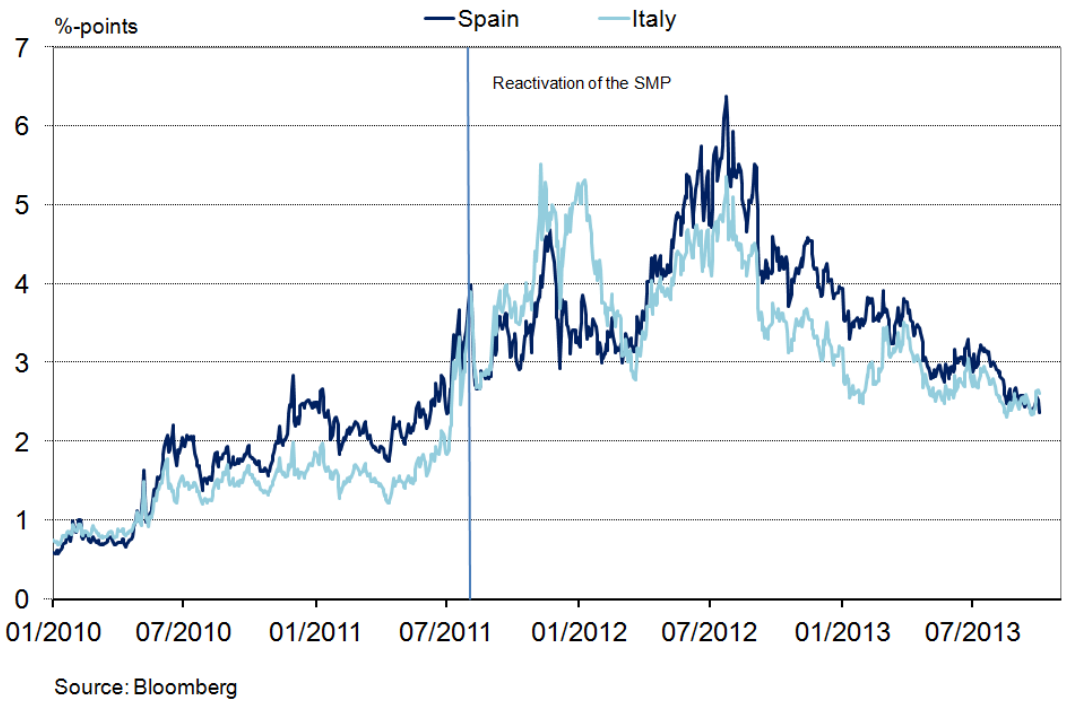
Figure 15 10-year yield spreads versus Germany. Rising risk premiums of some euro area sovereigns were hampering the monetary policy transmission which prompted the ECB to respond.



Source: Bloomberg.
*Greek private sector involvement (PSI) took place on 12 March 12. Thereafter quotations are for new Greek bonds.

The euro area debt crisis continued to aggravate despite of the ECB intervention. The investor confidence in euro area periphery suffered heavily as both Ireland and Portugal were forced to request EU/IMF assistance in November 2010 and May 2011 respectively. Many euro area countries were obliged to implement significant austerity measures in order to improve their fiscal positions and maintain the investors' confidence. Budget cuts and structural reforms were often painful and the increased unease among the public led to political instability in countries such as Italy and Spain. This brinkmanship further increased the pressure on Italian and Spanish sovereign bonds as the markets feared they would also eventually need outside assistance in meeting their debt obligations. The bailout packages had not removed the fears of default but rather the markets were worried as ever about the contagion to other countries. Italian and Spanish 10-year yield spreads versus Germany roughly doubled in the first half of 2011 (Figure 15). In August 2011, the ECB responded by acknowledging the announced fiscal measures by the governments in Italy and Spain and said they would again actively implement their SMP purchases which had been passive for quite a while. (ECB2011b)

Figure 16 10-year yield spreads versus Germany.ECB decided to again actively implement its Securities Markets Program after the tensions in Italian and Spanish bond markets had also escalated.



In terms of market developments, it quickly became evident that the ECB intervention was not enough to calm the markets. In March 2012, private sector debtors suffered heavy losses as Greek sovereign bonds were restructured under what was called private sector involvement (PSI). However, the ECB's holdings were exempt from restructuring. There was no official statement on a bond swap between the Greek Republic and the ECB but in a monetary policy press conference president Draghi indirectly admitted that the ECB and the national central banks in the Eurosystem had swapped their Greek debt holdings in SMP and investment portfolios for new bonds (ECB2012a). In spring 2012, contagion to other peripheral countries had become so severe that even the viability of the common currency was ever more often questioned. These fears were ever intensified as the markets realized the ECB's special treatment in the Greek debt restructuring and were worried about the ECB's seniority status in potential forthcoming restructuring events. In the summer 2012, the risk premiums on all euro area periphery countries rose to unprecedented levels. In response to these developments, in August 2012, the ECB announced a tentative plan to address the severe malfunctioning in the price formation process in the euro area bond market (ECB2012b). The ECB stated that it may undertake outright open market operations within its mandate to repair monetary policy transmission. Later, the ECB announced further technical features related to the Outright Monetary Transactions (OMT).

Under the OMT, the ECB could conduct outright transactions in secondary sovereign bond markets to safeguard an appropriate monetary policy transmission and the singleness of the monetary policy. The OMT was designed to address severe distortions in sovereign bond market that originate from unfounded fears on the part of investors of the reversibility of the euro (ECB2012d). The transactions would be focused on sovereign bonds with a residual or face maturity of one to three years and the ex ante amount would be unlimited. To be eligible for an OMT program, a country has to have an appropriate European Financial Stability Facility/European Stability Mechanism (EFSF/ESM) program in place. By announcing the OMT program, the ECB simultaneously terminated its SMP program which had already been passive for months. (Press Release: Technical features of Outright Monetary Transactions, 2012)

The OMT program has been criticized for undermining incentives for reform at national level, for violating the monetary financing prohibition, for conducing inflation and for exposing the central banks' balance sheet to risks that may eventually lead to fiscal redistribution among euro area countries. The ECB Executive Board member, Benoit Coeure, has responded to the criticism in his speech in Berlin (Coeure, 2013). He addresses the first criticism by acknowledging the strict conditionality related to the OMT. A country needs to have an appropriate EFSF/ESM program in place, to be eligible. In addition, the ECB would not buy bonds under the OMT, when a macroeconomic adjustment program was under review (ECB2012e). Coeure addresses the second point of criticism, the violation of monetary financing prohibition, by emphasizing that the OMT is a complement to national reform efforts and that the ECB makes the decisions related to the OMT fully independently. He clarifies that the OMT would never be used to push down government bond spreads that are due to economic fundamentals. Regarding the inflation risks created by the OMT, Coeure recalls that the ECB has all the necessary tools to maintain price stability. Also, the sterilization aspect plays an important role here[29]. For the last criticism, the balance sheet risks, Coeure stresses the financial stability point of view; when unfounded risk premiums is removed, the overall risks in the economy decrease. In addition, he claims that the strict conditionality fosters incentives for sound economic and fiscal policies and the limiting of the residual duration to 1-3 years also limits the duration of the risk exposure to a given creditor.

[29] As well as the liquidity effect from purchases under the SMP program, also the liquidity effect from purchases under the OMT program would be fully sterilized. Thus, the OMT would not be a liquidity injection in the banking system.

The ECB has stressed that its outright asset purchase programs have been established to support the monetary policy transmission mechanism. Regarding the transmission channels that were discussed in Chapter 2, the CBPP programs were obviously designed to support the credit channel of the transmission mechanism. The same channel was probably targeted with the SMP and the OMT as both of them had the objective to decrease fragmentation and address the issue of different credit conditions across the euro area. Also, the asset price channel should play a role. Furthermore, as the OMT has not been activated, it can be concluded that it has actually supported the transmission mechanism through signaling channel. Chapters 4 and 5 will study and assess the announcement effects of the OMT in the sovereign bond market in further detail.

3.2.6 Forward guidance

During the last two decades, there has been an evolution towards more transparency in central bank decision-making. As Woodford (2005) points out, before the 1990s, central banking was swathed in mystery. For example, the Federal Reserve did not communicate its policy rate decision to the public before 1994. It was the surprise element of the monetary policy decision-making that was believed to be the key to a central bank's success. The views have dramatically changed since then. It is now believed that central bank communication greatly contributes to the monetary policy effectiveness (Blinder;Ehrmann;Fratzscher;De Haan;& Jansen, 2008). Thus, expectations management by the means of communication and increased transparency has become a key monetary policy instrument. Furthermore, it is now seen as one of the basic tasks of central banks. Thus, central bank communication, as such, is by no means unconventional but rather is a vital part of the conventional framework. However, due to the characteristics of the ECB's communication and the changes in its communication strategy lately, I have decided to categorize the forward guidance as an unconventional monetary policy measure.

The theoretical framework for evaluating the importance of central bank communication lies in the term structure of interest rates. According to Cox et al. (1985), long-term interest rates reflect the expectations of short-term rates at that time. Since short-term rates normally are the operational targets of many central banks, the central banks can affect the long-term interest rates by managing the public's expectations on future short-term rates. The easiest way for a central bank to shape the expectations about future short-term rates is by communicating effectively to the public about its expectations on economic development, monetary policy strategy and reaction function. Indeed,

major central banks have various ways of communication. The Federal Reserve provides the public with a statement on monetary policy after each Federal Open Market Committee (FOMC) meeting. It also publishes the minutes of each meeting with a few weeks delay. The ECB organizes a press conference after each Governing Council meeting. In the press conference, the president of the ECB reports the outcome of the meeting and explains the Governing Council assessment on economic and monetary developments. All major central banks also publish economic forecasts regularly to express their views on future economic development.

During the crisis, in an atmosphere of central banks facing ever-increasing pressure for transparency, many major central banks have put more emphasis on communication issues. The expectations management practiced in a more organized and determined way by major central banks has been labeled forward guidance. Before going in detail to the forward guidance pursued by the ECB, it is useful to provide a theoretical viewpoint. The most cited article in recent discussion about central bank forward guidance is the paper by Campbell et al. (2012). The authors distinguish two main types of forward guidance, Delphic and Odyssean. The issue relates to a more general discussion about whether policies should be rule-based or have room for policymakers' discretion. These problems have been discussed e.g. in Fischer (1990).

Delphic approach marks the softer version of forward guidance. It publicly states a forecast of macroeconomic performance and likely or intended monetary policy actions based on the policymaker's potentially superior information about macroeconomic fundamentals and its own policy goals. Delphic forward guidance, then, should improve macroeconomic outcomes by reducing private decision maker's uncertainty. Importantly, Delphic forward guidance does not commit the policymaker to any particular course of action. Rather, it is always conditional to certain policymaker's expectations on future development. The challenge of Delphic forward guidance is how to make it effective and credible when there is no commitment.

In contrast, Odyssean approach does commit the policymaker. In Odyssean forward guidance, the central bank publicly commits to certain future action unconditionally. By doing so, the central bank can change the public expectations of their actions tomorrow in a way that improves the macroeconomic forecast today. One of the challenges in Odyssean forward guidance is the time-inconsistency problem. When the policymaker has committed to certain future action, it has to stick to that no matter what happens. When the time comes, the economic environment might not

correspond to the expectations of the central bank on the grounds of which it had given the forward guidance. Nevertheless, the central bank has to stick to its promise or it will compromise its credibility in views of the public. However, keeping its commitment might risk the central bank violating its own mandate. This might happen, for example, if the inflation had increased more than the central bank had initially expected. All in all, forward guidance is always a trade-off, on one hand, between increasing its credibility and hopefully magnifying its effects by making a strict commitment, and on the other hand, protecting the risks to the mandate and making a softer, conditional commitment which might not have that big effects.

Several scholars have studied the effects of forward guidance. Gurkaynak et al. (2005) conducted a high-frequency event study on whether the changes in asset prices after FOMC meetings are adequately captured by the changes in the federal funds target rate and find that they are not. Instead, they find that asset prices respond to two factors: current federal funds target rate and a future path of the policy. According to their findings, the statements (the communication) that give hints on future path of the policy especially have important impact on longer-term Treasury yields. Their study is in line with the theory on the term structure of interest rates. Managing the expectations by publishing a statement has larger effects on long-term rates whereas outright changes in the current policy rate have larger effects on short-term rates.

In addition, Eggertsson and Woodford (2003) show that a credible commitment by a central bank to a future policy can somewhat help escape the constraints of the zero lower bound. Assuming a binding zero lower bound for interest rates, the probability distribution for expectations on future short-term rates is skewed when the policy rate is near zero. The more the public has information on the future path of policy (so the less the uncertainty) the skinnier will be the tail for higher rates. In contrast, when the uncertainty is high, the tail is fat. The central bank can impact the probability distribution by committing to low rates and reducing uncertainty and hence effectively lower the interest rate expectations.

The ECB communicates with the public in various ways. As already mentioned, the ECB conducts press conferences after its interest rate decisions. In addition, it publishes macroeconomic forecasts on a quarterly basis. Also, the Governing Council members give speeches and interviews which, of course, often give the market and the public an insight to what is the ECB’s current stand and what are their expectations on future development. Observers had also recognized a certain use of “code

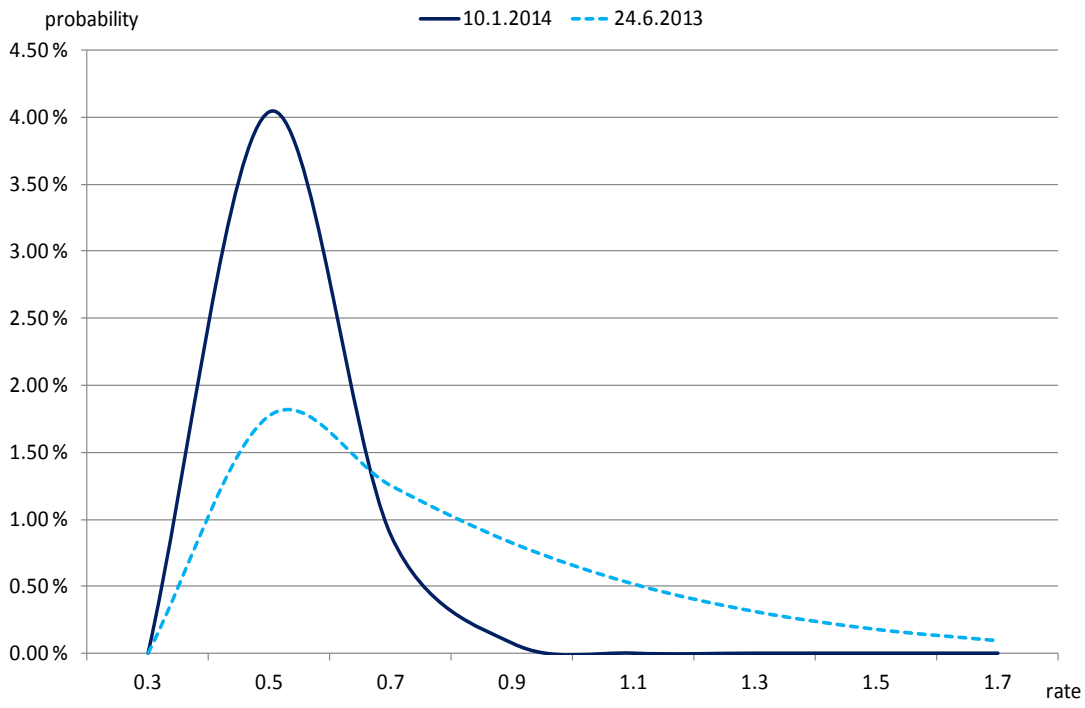
words" in the ECB language, which would give hints on future actions. However, explicitly, the ECB for long emphasized that it "never pre-commits" to future action. The phrase was introduced by the previous ECB president Jean-Claude Trichet and was also a vital part of its successor's, Mario Draghi's, vocabulary.

After the Federal Reserve gave early signs of tapering their asset purchases in spring 2013, there was a strong upward pressure in money market rates and bond yields on both sides of the Atlantic. As a response, a significant change to the ECB's stance of never pre-committing followed in July 2013 when Draghi said the following words in the monthly press conference: "*The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time. This expectation is based on the overall subdued outlook for inflation extending into the medium term, given the broad-based weakness in the real economy and subdued monetary dynamics. In the period ahead, we will monitor all incoming information on economic and monetary developments and assess any impact on the outlook for price stability.*" (ECB2013b). In the press-conference, Draghi described the ECB's step as unprecedented. Figure 16 shows how the market pricing has changed after the ECB started forward guidance. The 3-month Euribor future options market is pricing a much lower probability for high rates than it was in June before the announcement.

In light of the theory, the ECB's forward guidance can be labeled as the softer type, Delphic forward guidance. The ECB has not, like Odysseus, tied itself to a mast. Instead, it is simply communicating that in light of the current information it sees an overall subdued inflation outlook extending into the medium-term which would justify keeping rates at current or lower levels for an extended period of time. However, should the outlook change, so would the forward guidance.

As I have showed, the ECB's monetary policy response to the crisis has been a mix of measures ranging from assuring sufficient liquidity conditions for the banking sector in times of crippling uncertainty to improving the transmission mechanism in times of deep fragmentation in monetary conditions across the euro area countries. The ECB has emphasized its role as the backstop of the banking sector and as the fosterer of the single currency. Next, I will evaluate the effectiveness of some of these unconventional measures in terms of financial market effects. Namely, I will show how the ECB three-year refinancing operations and the announcement of the OMT have significantly eased the tensions in the euro area financial market.

Figure 16 The 'forward guidance' announcement by the ECB has decreased the uncertainty related to future short-term interest rates.



Source: Bloomberg, probability distributions derived from 3M Euribor future contract (Dec2014) options

3.2.7 Emergency lending

In addition to liquidity provision in general monetary policy implementation framework, the NCBs in the Eurosystem also have the possibility of providing emergency liquidity assistance (ELA) to their counterparties. ELA is not a monetary policy measure, neither is it an ECB measure. However, as the provision of emergency liquidity assistance impacts the money market conditions similar to any other Eurosystem refinancing, I will provide a short introduction here.

ELA means the provision of central bank money or any other assistance that may lead to an increase of central bank money by a Eurosystem NCB to a solvent financial institution (or a group of institutions) that is facing temporary liquidity problems. Responsibility for the provision of ELA lies within the NCB(s) concerned which means that the costs and risks related to ELA are incurred by the relevant NCB. However, as there is a prerequisite that the ELA operations shall not interfere with the objectives and tasks of the Eurosystem, the Governing Council of the ECB has to be informed of any ELA operations in a timely manner. More precisely, the NCBs are obliged to

inform the ECB of the details[30] of any ELA operation within two business days after the operation was carried out. If the overall volume of the ELA provided by the NCB exceeds 500 million euro the ECB must be informed as early as possible before extending assistance. Furthermore, if the overall volume exceeds 2 billion, the Governing Council considers whether there is a risk that the ELA provided will interfere with the objectives and tasks of the Eurosystem. Even in that case, the Governing Council can decide to set a threshold and not to object any ELA provision up to that threshold. (ECB, ELA Procedures, 2013)

4 Data and methodology

In Chapter 3, I discussed unconventional monetary policy measures in general and explained how they transmit to the economy via the different channels of the transmission mechanism. This part of the study will present the data and methodology that I use to evaluate whether some of the measures conducted by the ECB, to be precise, whether the three-year longer-term refinancing operations (LTROs) and the Outright Monetary Transactions (OMT) announcement had market-calming effects. In both cases, I evaluate the effects on the sovereign bond market. For the three-year LTROs I also examine the effects on the money market.

This study is focused on two ECB measures; the 3-year long-term refinancing operations and the OMT, which both could affect the market through different channels, mainly through the credit channel and the signaling channel but also, perhaps, through the asset price channel. Here, it is important to distinguish action from words (announcements). As I am concentrated on the announcement effects, I interpret that the market reactions (before the central bank actually takes any action), result from the functioning of the signaling channel. That is when the market prepares for central bank action. For portfolio-rebalancing (*asset price channel*) to take place, the latter has to implement the measures. The same applies to credit channel. Naturally, when the market reacts to the central bank *action* the result is a sum of the effects from these different transmission channels; the portfolio-rebalancing takes place and the credit channel hopefully works but also the market perception of a central bank standing behind its words strengthens and, thus, the signaling channel works too.

[30] The information needs to include the counterparty to which ELA has been or will be provided, the value and maturity date of the ELA and the volume of the assistance. In addition, the ECB needs to be informed about the currency in which the ELA is provided, about the collateral and the haircuts applied as well as the interest rate to be paid by the counterparty. The NCB also has to inform the ECB about the specific reasons for the ELA and provide a prudential supervisor's assessment of the liquidity situation and solvency of the counterparty that is receiving the ELA.

For the 3-year refinancing operation, there are five events, which include both announcements on future action and the actions themselves. On the contrary, for the OMT, there are three events, none of which include actual central bank action. Thus, for the OMT, I will only study the market effects of these announcements and determine whether they have been effective alone. It is indeed possible and, for example, Cecioni et al. (2011) pay attention to the fact that by assuring markets about the central bank's role as a lender of last resort and by providing an implicit guarantee of the intermediation role of the central bank, the announcement itself may influence the market even before any action is taken.

Before presenting the events in further detail, it is essential to justify the choice of methodology. Section 4.1 explains the event study methodology and presents a related study. Section 4.2 identifies the key events and event windows for the three-year LTROs as well as presents the hypotheses for the study on the market impact of the LTROs. Section 4.3, respectively, identifies the events and event windows for the OMT and presents the hypotheses for the study on the market impact of the OMT.

4.1 Event-study methodology

To study the effects of the specific unconventional measures, conducted by the ECB, I will apply high-frequency event study methodology using the daily data from financial markets obtained from Bloomberg. The data points are from the market closing. My data covers the sovereign bond yields from Germany, Italy, Spain, Ireland, Portugal and Greece, out of which I have calculated out the risk premiums (yield spreads versus Germany). My review excludes the Irish 10-year, since there was quite a long phase in my review period during which Ireland did not have a 10-year benchmark bond. Also, my review excludes the short end of the Greek yield curve since after the PSI, the shortest maturity in Greek debt stock was 10 years.

For the three-year LTROs, I use data from period 1.1.2010-6.12.2011. The data begins from 2010 because I want to avoid the problem of overstating results. During the crisis, the sovereign bond market has been very volatile and there have often been large daily movements in spreads. Hence, using data from a period before the crisis would probably lower the standard deviations and, thus, the results could seem more significant than they actually should considering the circumstances. For the OMT, respectively, I use data from period 1.1.2010-25.7.2012.

A high-frequency event-study analysis uses changes in financial markets in a narrow window of time around major, discrete announcements to measure the effects of those announcements. Under the hypothesis of rational expectations in financial markets, asset prices should completely incorporate all information from a public announcement shortly after the announcement is made (Swanson, 2011). In the case of ECB three-year LTROs, I will study one- or two-day changes in the sovereign yields of distressed euro area countries as well as the changes in the money market after each relevant announcement regarding the LTROs took place. For the OMT, I will follow the same steps and evaluate the one-or two-day changes in the sovereign yields after each announcement.

Swanson (2011) exploited a high-frequency event study when he evaluated the effects of the Federal Reserve's Operation Twist in the 1960s. The author detected six announcements relating to the implementation of Operation Twist and compared the changes in the Treasury markets in a specified event window to the unconditional standard deviations. Swanson rejected the null hypothesis and find that the Federal Reserve's announcements had significant effects on the Treasury yield curve. I will follow the same approach in my study and I will start by reasoning the choice of the methodology.

As Swanson (2011) points out, announcement effects are hard to evaluate with low-frequency data. Evaluating the weekly or quarterly changes in sovereign bond yields or money market rates would require knowledge about other macroeconomic variables, news events or monetary policy decisions that might also have an effect on the observed price changes. Using the daily data, it is fairly safe to assume that there are no other factors contributing to the price change. Obviously, to make that assumption, I need to study whether there were any significant data releases or other market-moving events on the same day with the announcements that could have either magnified or reduced the announcement effect of the measure under study. I will control this factor when I present my results.

Another issue justifying the choice of methodology is the issue of endogeneity. Money market rates and long-term bond yields reflect the monetary policy stance, but also, monetary policy stance can change due to developments in these markets. Thus, with low-frequency data, the effects can be ambiguous. With high-frequency data, this problem can be avoided since I know that the events were not originated because of the price change that occurred on the same day of the event.

The rationale of event study is explained eg. in MacKinlay (1997). The initial task of conducting an event study is to define the event(s) of interest and identify the period over which the particular event(s) have affected the market – the event windows. In the next sections, I will present the event windows and the hypotheses. I will identify the key events and announcements relating to the ECB three-year LTROs and the OMT and explain the choice of an event window for each of them.

4.2 Three-year LTRO

4.2.1 Event windows

To perform an event study analysis on the market impact of the three-year LTROs, I must first identify major announcements that relate to these measures. I will include all the relevant events that can be associated with the implementation of the LTROs as well as all the events that significantly have affected the amount of liquidity that is created through this facility. In all, I identified five key events out of which the first one is the actual pre-announcement of the two three-year LTROs. The next two events are the allotment dates of the two LTROs revealing the actual amount of liquidity that was injected to the banking system through these operations. The last two events are the first possibilities for an early repayment for both of the three-year LTROs respectively. I will include these last two events because they essentially affect on the outstanding amount of liquidity that was created in the two operations.

On 8 December 2011, the Governing Council of the ECB announced measures to support bank lending and money market activity (ECB2011e).This decision was four-fold. First of all, the ECB decided to conduct two longer-term refinancing operations with a maturity of 36 months and the option of early repayment after one year. In addition, the ECB announced that it would discontinue liquidity fine-tuning operations that had taken place on the last day of each maintenance period, that it would reduce the reserve requirement ratio for banks from 2 % to 1 % and that it would increase collateral availability. Furthermore, the ECB also cut the policy rate. The discontinuation of fine-tuning operations made sense since there was a significant liquidity surplus in the banking system due to full allotment procedure. The latter two measures were important complements to the GC's decision to conduct the two LTROs. The lower reserve ratio further relieved the liquidity conditions and the increase in collateral availability was a necessary step to make sure that the banks would have adequate collateral should they participate in the two LTROs.

In my study, the impact of this first event is the most complex to evaluate. It would be difficult to separate the effects of the LTRO announcements from the effects of these other announcements that took place simultaneously. Hence, I will actually study the market developments of the day before. There was a leak on Bloomberg on the previous day that mentioned the possibilities of the ECB conducting special long-term operations, cutting the policy rate and widening the collateral framework. (Bloomberg, 2011) The news came out in late European afternoon which gave the markets a few hours time to react. To avoid the problem of overstating the effects of the LTRO announcement, I will only evaluate the market effects on December 7th as the markets were already then prepared for ECB's liquidity injections. Naturally, it is still impossible to separate the effects of other rumors (especially those related to rate cut and collateral loosening) from the rumors related to liquidity operations.

The next two events are more straight-forward. The second event date is December 21st 2011 when the ECB announced the allotment result of the first three-year LTRO that was settled on the next day (ECB, Open market operations, 2011). Respectively, my third event date is December 29th 2012 when the ECB announced the allotment result of the second three-year LTRO (ECB, Open market operations, 2012). Both of these allotment results were announced at noon, so the markets had plenty of time to react. Thus, my event windows for the above mentioned events will also be for one day each.

The last two events mark the first opportunities for early repayments on the two LTROs. The early repayment option was a unique feature in the ECB tender operations. Regarding the first LTRO, the ECB announced the result of the first repayment opportunity on 25th of January 2013. Respectively, for the second LTRO, the ECB announced the first repayment result on 22nd of February 2013. The general feature of the LTROs was that there would be a weekly possibility for banks to repay their loans once the window was open. Thus, the repayments continued gradually after the first opportunity. However, as the amounts were much smaller after the first opportunity and, thus, the effect on liquidity conditions was much less significant, I will only cover these two events in my study.

4.2.2 Hypothesis tests

My assumption is that a liquidity injection created by the 3-year refinancing operations would lead to a re-pricing in the sovereign bond market and thus to rising prices and falling yields. The effect on asset prices stemming from an extension of the maturities of central bank's refinancing operations was already mentioned in Section 3.2.2 and has been presented in Cour-Thimann and Winkler (2013). For the first event, one could, thus, expect that a liquidity injection from the central bank should, in times of systemic stress, alleviate banks' pressure to deleverage and would thus indirectly support the sovereign bond market which had been severely hit by the fire sales. The vicious circle of deleveraging could halt as soon as the markets know that the central bank will intervene in the future. This is captured in the first event.

Hypotheses for the first event:

H0: no decreasing effect on distressed sovereign bond spreads

H1: statistically significant decrease in distressed sovereign bond spreads

However, it is important to note that for events 2-5 the expected effect on sovereign bond spreads is not as straight-forward. Rather, the expected effect depends on the overall market expectations and especially on the size of the allotment compared to market expectations. Regarding the expectations related to events two and three, there was a general understanding in the market that the ECB's liquidity facility had been established to be used. ECB advocates had downplayed the stigmatization related to central bank refinancing and encouraged the banks to make good use of this refinancing opportunity (WSJ, 2012). Thus, I conclude that there was a consensus among market participants that a higher take-up from the LTROs would be perceived as a positive. Thus, my null hypothesis is that when the actual allotment is above the median expected allotment the sovereign spreads would increase or be unchanged. Respectively, my alternative hypothesis is that when the actual allotment is above the expected allotment the sovereign spreads would decrease.

Hypotheses for events two and three, when E (allotment) < A (allotment):

H0: no decreasing effect on distressed sovereign bond spreads

H1: statistically significant decrease in distressed sovereign bond spreads

For the second event (*the first three-year LTRO allotment*), the median expected allotment in a Reuters poll was 310 billion euro, whereas the actual allotment came in at 489 billion (Reuters, 2011). Thus, the actual allotment rose well above the median forecast and my alternative hypothesis is that the sovereign spreads should fall. For the third event (*the second three-year LTRO*), the median expected allotment, according to Reuters, was 500 billion euro (Reuters, 2012). The actual allotment, in turn, was 529 billion topping the expectations. Thus, also for the third event, my alternative hypothesis is that the sovereign spreads should fall.

Regarding the expectations related to events four and five; one needs to understand the prevailing market conditions at the time the repayment window was opened. Media reports evidently show that there was a weak consensus but no unanimity about whether high repayment figures would be interpreted as a positive or as a negative. There were arguments that high repayment amounts would signal a debt crisis relief and reflect improved bank funding positions. On the other hand, some market participants were worried about the unfavorable market effects of waning liquidity. I will test whether a higher than expected repayment amount was perceived as a positive because it would reflect improved funding positions in crisis hit countries. Thus, my null hypothesis is that when the actual repayment was below the expected repayment, the sovereign spreads would increase or be unchanged. My alternative hypothesis is that when the actual repayment was above the expected repayment, the sovereign spreads would decrease.

Hypotheses for repayment events, when E (repayment) < A (repayment):

H0: no decreasing effect on distressed sovereign bond spreads

H1: statistically significant decrease in distressed sovereign bond spreads

For the fourth event (*first repayment opportunity of the first LTRO*), the median expectation in a Reuters poll was for a 100 billion repayment (Reuters2013a). The actual allotment came in at 137 billion topping the expectations. Hence, for the fourth event, my alternative hypothesis is that there should be a statistically significant decrease in distressed bond spreads. For the fifth event (*first repayment opportunity of the second LTRO*), the median expected repayment was 130 billion, whereas the actual repaid amount was 61 billion (Reuters2013b). Thus, the actual repayment was lower than expected. This would turn the hypotheses around. Indeed, for the fifth event, my

alternative hypothesis is that there was no decreasing effect on distressed sovereign bond yields. Table 1 summarizes the key events related to the three-year LTROs.

Table 1 Significant announcements regarding the three-year LTROs

Announcement date	Time (GMT + 2)	Description	Exp. Effect on Sovereign Bond Spreads	Event Window
Dec. 7, 2011	15:00	Bloomberg leak: ECB to conduct two VLTROs	decrease	1 day (Dec. 7)
Dec. 21, 2011	12:15	ECB announces the allotment result of the first 3-year LTRO	decrease*	1 day (Dec. 21)
Feb. 29, 2012	12:15	ECB announces the allotment result of the second 3-year LTRO	decrease*	1 day (Feb. 29)
Jan. 25, 2013	13:00	ECB announces the result of the first early repayment possibility of the first 3-year LTRO	decrease**	1 day (Jan. 25)
Feb. 22, 2013	13:00	ECB announces the result of the first early repayment possibility of the second 3-year LTRO	decrease**	1 day (Feb. 22)

*if E(allotment) < actual allotment
**if E(repayment) > actual repayment

4.3 Outright monetary transactions

4.3.1 Event windows

To perform an event study analysis, I must first identify major announcements that relate to the Outright Monetary Transactions program announcement. I will conclude all the events which, in the eyes of the market participants, were interpreted to involve information about the OMT, even if the name or the technical features of the program were not yet published. I started by taking a retrospect from the actual announcement of technical features that took place in September 2012. Indeed, I identified two events before the actual announcement that were laying the ground for the actual announcement. Thus, I have three events and I will present them each in turn, chronologically starting from the first event on July.

The first event that can be considered to lay the foundations for the actual OMT announcement took place on July 26th 2012. On that day, the president of the ECB, Mario Draghi, gave a speech at the Global Investment Conference in London (Draghi, 2012). In his speech, Draghi had three points out of which the last one is the most relevant for this study. The last point in Draghi's speech was, quoting his own words, "*in a sense more political*". Draghi emphasized the political capital that is being invested in euro, and more importantly, said that "*we think the euro is irreversible*". Even more importantly, Draghi gave a promise: "*Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough*." That promise was something unparalleled. Especially when Draghi added: "*To the extent that the size of these sovereign premia hampers the functioning of the monetary policy transmission channel, they come within our mandate*." It is justified to say that these remarks made in London were a promise of an ECB measure that will address the problem of high sovereign risk premiums. Thus, July 26th, is the first event date. Since the remarks came through the newswires in the early European afternoon, the markets had plenty of time to react and digest the news. The decrease in the sovereign spreads continued on the next day but to avoid overstating the results my event window will only cover one-day changes.

The second event that can be considered closely relate to the actual OMT announcement took place in August 2nd 2012. After the Governing Council (GC) meeting in August 2012, Draghi gave his monthly press conference. In the introductory statement, he said that the GC had "*extensively discussed the policy options to address the severe malfunctioning in the price formation process in the bond markets of euro area countries*" (ECB2012d). He pointed out that the financial fragmentation hinders the effective working of monetary policy and repeated his phrase about the irreversibility of the euro. In addition, Draghi stated that the GC "*within its mandate to maintain price stability over the medium term and in observance of its independence in determining monetary policy, may undertake outright open market operations of a size adequate to reach its objective*". He promised that the appropriate modalities would be designed "*over the coming weeks*". These remarks, even if they were lacking details, confirmed that the ECB was preparing something to address the high sovereign risk premiums. The markets were still a bit in the dark with respect to the form of the new measures but at least a hint was given: The ECB "*may*" undertake outright open market operations. Thus, the introductory statement on the ECB's press conference on 2nd of August marks the second event. As the press conference took place according to the normal

schedule, in the European afternoon, I consider the markets to have had enough time to react to the news on the same day and my event window will be for one day only.

The third event is the actual OMT announcement that included the technical modalities for the program. On September 6th, after the monthly GC meeting, Draghi presented the technical features of the OMT in the regular press conference (ECB2012d). In his introductory statement, Draghi said that the GC "*today decided on the modalities for undertaking Outright Monetary Transactions (OMTs) in secondary markets for sovereign bonds in the euro area*" in order to preserve the singleness of monetary policy and to safeguard the transmission mechanism. The technical features of the OMT included the terms of conditionality, coverage, creditor treatment, sterilization and transparency in the program (ECB2012c). However, this time, the technical features did not surprise the market anymore. Indeed, there was a leak on Bloomberg on the previous day that had already revealed most of the details of the program (Bloomberg, 2012). Indeed, the facts that the program would target sovereign bonds with maturities up to three years, that the purchases would be unlimited and that the liquidity would be sterilized, were all released on the Bloomberg news on September 5th. Thus, for the third event, I will study the changes in the sovereign risk premiums in a two-day window, 5-6th September. Table 2 summarizes the key events related to the OMT.

Table 2 Significant announcements regarding the OMT

Announcement date	Time (GMT + 2)	Description	Exp. Effect on Sovereign Bond Spreads	Event Window
Jul. 26, 2012	14:00	ECB President Draghi gives speech in London: "The ECB will do whatever it takes to preserve the euro"	decrease	1 day (Jul. 26)
Aug. 8, 2012	15:30	ECB press conference, Draghi: "The euro is irreversible. Over the coming weeks, we will design the appropriate modalities for such policy measures [open market operations]"	decrease	1 day (Aug. 8)
Sep. 6, 2012	15:30	ECB announces the technical features of the Outright Monetary Transactions - leak to media on the previous day	decrease	2 days (Sep. 5-6)

4.3.2 Hypothesis tests

The null hypothesis for my analysis is that the three announcements relating to the OMT had no effect on distressed sovereign bond spreads. The alternative hypothesis is that the announcements relating to the OMT should lead to suppressing bond spreads. The effect should come through the signaling channel. If the ECB is making an unparalleled and credible commitment to address the sovereign risk premiums in case they hamper the transmission of monetary policy, the financial markets should, indeed, change their perception on the riskiness of these sovereigns if the ECB communicates that the risk premiums are unfounded.

In all the three events, Draghi highlighted that the sovereign risk premiums at the time reflected unfounded fears of the reversibility of the euro. In his London speech (first event), Draghi pointed out that the risk premiums reflected the "*risk of convertibility*". In August (second event), Draghi said that "*risk premia that are related to fears of the reversibility of the euro area are unacceptable*". In September (third event), Draghi emphasized that there are "*severe distortions in government bond markets*". After these emphatic remarks, the markets should have realized that the ECB's perception on the risks related to the distressed sovereigns significantly deviated from the market's perception. Now, if the markets had considered the ECB's commitment to address these price distortions, they should have reacted. To elaborate, there should have been a price correction in the sovereign bond market where the markets would have re-priced some of the sovereigns to better reflect the ECB's viewpoint. Not re-pricing would have been irrational since it could have led to ECB action i.e. ECB buying bonds and forcing the prices up (and yields down). It would only be rational if the market did not consider the ECB's commitment credible. Thus, my hypotheses are the following.

H0: No decreasing effect on distressed sovereign bond spreads

H1: A statistically significant decrease in distressed sovereign bond spreads

5 Results

5.1 Three-year LTROs

The results of the event study analysis described in Section 4.2 are summarized in Table 3. The panel reports the change in sovereign bond spreads across the event window for each announcement. Below, Table 4 reports the standard deviations and the average changes over the

time period under review. It shows that the Greek and Portuguese bonds have been the most volatile followed by Ireland. The Italian and Spanish sovereign bonds have experienced roughly the same level of volatility. The statistical significance of each sovereign spread response in the table is assessed relative to the standard deviation for the same maturity and the window size. One or two stars denote statistical significance with 95 % and 99 % level for a two-sided t-test. I am considering two-sided p-values because the significant market volatility during the crisis has resulted in large price (and yield) moves to both directions and also because I want to avoid overstating the significance of the results. Dark cells denote a change that is against the alternative hypothesis. In other words, it shows an increase in spreads when a decrease was expected.

The *first event*, the leak on Bloomberg about the ECB considering special longer-term refinancing operations, did not have a very positive impact on the market. As Table 3 shows the bond spreads actually widened in Spain, Italy and Greece. On the other hand, the spreads narrowed in Portugal and Ireland yet the changes were statistically significant only in Portugal and in the Irish 5-year sector. A possible explanation is that the European political environment was very tense at the time and the markets were expecting not only the outcome of the ECB meeting on 8th of December but also the outcome of an EU summit on 9th of December where the political leaders of the EU were discussing a fiscal compact. The fiscal compact was supposed to restore confidence in budget discipline as woes on debt sustainability had derailed the European economy. One could argue that my choice of event window could tell a false story since the actual ECB decisions were only announced on the day following my event date, on December 8th. However, the event window choice, in this case, does not change the picture since the data reveals that the spreads also widened the next day (on the day of the ECB meeting). Even the positive reaction in Portugal and Ireland is not very remarkable considering that at the time their bond markets were subject to very high levels of volatility. Yet, as the results are statistically significant we can accept the alternative hypothesis for Portugal and partially for Ireland.

Table 3 Changes in sovereign bond spreads in event windows in basis points. A dark cell denotes a change to the opposite direction of the alternative hypothesis forecast.

Changes in sovereign bond spreads versus Germany (bps)			
	Spain 2yr	**Spain 5yr**	**Spain 10yr**
7.12.2011	41**	28**	31**
21.12.2011	27**	14**	23**
29.2.2012	-11**	-9**	-6**
25.1.2013	-11**	-17**	10**
22.2.2013	3**	-1	-5**
	Italy 2yr	**Italy 5yr**	**Italy 10yr**
7.12.2011	9**	19**	21**
21.12.2011	9**	13**	20**
29.2.2012	-29**	-24**	-18**
25.1.2013	-6**	-12**	-10**
22.2.2013	0	-5**	-4**
	Portugal 2yr	**Portugal 5yr**	**Portugal 10yr**
7.12.2011	-117**	-15**	-20**
21.12.2011	43**	0*	-7**
29.2.2012	-9**	76**	71**
25.1.2013	-5	1*	7**
22.2.2013	5	0*	-2
	Ireland 2yr	**Ireland 2yr**	**Ireland 10yr**
7.12.2011	-3	-25**	
21.12.2011	0	-4**	
29.2.2012	36**	12**	
25.1.2013	-3	-9**	
22.2.2013	5*	4**	
	Greece 2yr	**Greece 5yr**	**Greece 10yr**
7.12.2011	166*	259**	100**
21.12.2011	-6**	8	100**
29.2.2012	-238**	81**	41**
25.1.2013			-22**
22.2.2013			-5
*indicates that the change is statistically significant with a 95 % confidence level			
**indicates that the change is statistically significant with a 99 % confidence level			

Table 4 Average changes in bond spreads and standard deviations.
The data is collected from 1.1.2010 until the day before the first event (6.12.2011).

	Spain 2yr	**Spain 5yr**	**Spain 10yr**
1-day average chg (bps)	0.6	0.6	0.5
1-day standard dev. (bps)	14.4	13.6	11.5
	Italy 2yr	**Italy 5yr**	**Italy 10yr**
1-day average chg (bps)	1.0	0.9	0.6
1-day standard dev. (bps)	16.5	14.6	11.5
	Portugal 2yr	**Portugal 5yr**	**Portugal 10yr**
1-day average chg (bps)	3.3	2.8	2.1
1-day standard dev. (bps)	44.2	31.1	21.1
	Ireland 2yr	**Ireland 2yr**	**Ireland 10yr**
1-day average chg (bps)	1.6	1.4	
1-day standard dev. (bps)	46.0	32.3	
	Greece 2yr	**Greece 5yr**	**Greece 10yr**
1-day average chg (bps)			5.7
1-day standard dev. (bps)			45.8

The *second event*, the allotment of the first 3-year LTRO, also fell short of the desired outcome in the market. Mostly the spreads widened, especially in Spain and Italy, but also in Greece and Portugal. The alternative hypothesis can only be accepted in the Greek 2-year, Portuguese 10-year and the Irish 5-year sector. A possible explanation for a negative reaction in the sovereign bond market is that the markets actually perceived the high participation as an alarming signal of the state of the banking system. Indeed, some analyst views reflected this opinion (Reuters, 2011). There were no major data releases or other significant news on the second event day that could have offset an initial positive reaction. Hence, I conclude that both the first and the second event were not very effective in relieving the tensions in the distressed sovereign bond market, at least when it comes to immediate market response.

The *third event*, the allotment of the second 3-year LTRO, was better received in the market. The spreads narrowed in Italy and Spain. As Table 3 shows, the move was most remarkable in Italy where the yield curve steepened and shifted down 20-30 bps. The Spanish curve dropped 6-11 bps. Also, the changes in Portuguese and Greek 2-year sector are statistically significant and support the alternative hypothesis. On the other hand, the reaction in Ireland shows unexpected results and, there, the null hypothesis cannot be rejected.

Before declaring a success of the third event, it is necessary to have a look at other potential market drivers on the very same day. Indeed, what perhaps explains the underperformance of Greek and Portuguese spreads is the Greek PSI offer that had been published less than a week before the third event date. On February 28th, the ratings agency S&P had cut the Greek sovereign debt rating to selective default following the debt swap offer. Furthermore, late on the same day, International Swaps and Derivatives Association (ISDA) had announced that it would consider whether a potential credit event had occurred in Hellenic Republic[31]. A credit event would have triggered Greek credit default swaps (CDSs) which was likely to have caused severe market turbulence. Since Portugal was feared to follow Greece's path and end up with a debt restructuring negative news relating to Greece often increased pressure also in the Portuguese market. Regarding Ireland's underperformance, the news on Greece could be a partial explanation. Furthermore, on February 28th, the Irish prime minister had announced that a referendum would be held about the EU fiscal compact. Since the referendum was interpreted as weakening the possibility for further austerity programs in Ireland, spreads' widening could have also reflected the market's reactions to this news instead of the LTRO results.

In addition to the news on Greece and Ireland, the markets were also digesting a speech by the Fed chairman Bernanke for the House of Representatives on 29th February. Indeed, Bernanke's speech contributed to the general risk aversion on that day. Many market participants were expecting Bernanke to give hints on a third round of large-scale asset purchases but the speech gave no indication that the Federal Reserve would be preparing such an act. Hence, the markets were disappointed and the general risk aversion was evident e.g. looking at the performance of major stock indexes on that day. Risk aversion caused by the news related to Greece and Ireland as well as the speech by Bernanke could offset some of the positive reaction to the LTRO allotment. Nevertheless, the Italian and Spanish bond spreads did tighten even though there was general risk aversion. Thus, I conclude that the reactions to the third event support the view of LTROs being a powerful tool in mitigating the distress in the sovereign bond market.

[31] The question whether a potential credit event had occurred had been submitted to ISDA due to a retrospective activation of collective action clauses (CACs) on debt instruments issued by the Hellenic Republic. Also, the committee considered whether a change in the seniority status of the ECB triggered a credit event. More information on this can be found in ISDA press releases (www2.isda.org/newsroom).

The results of the *third and fourth events* should be interpreted from the point of view whether the repayments reflect improved bank funding positions. As explained in Section 4.2.2, a higher than expected aggregate repayment amount would show a narrowing in spreads if it was interpreted to reflect a decrease in bank funding stress whereas a lower than expected amount should result in widening of spreads if it was deemed to reflect no improvement in bank funding position. The expected direction of the changes is different in event four than it is in event five because the repayment in January 2013 was higher than expected (spreads should narrow) but the repayment in February 2013 was lower than expected (spreads should widen). Table 3 shows that, regarding the fourth event, the spreads did mostly tighten. Indeed, the spreads tightened in Italy, Ireland and Greece. Also, in Spain the spreads narrowed excluding the 10-year sector. The null hypothesis only holds in Portugal.

An overview on other market movers on January 25th, on the fourth event date, shows that there were also some other factors that could have contributed to the tightening of the spreads. Indeed, a closer look shows that a strong IFO index reading was published on the very same day that reflected improved business morale in Germany. Since the IFO index is one of the most closely watched economic sentiment indicators in the euro area, one cannot downplay its potential effect in the bond market. As a response, the German bond yields increased 8, 10 and 6 basis points on the day in 2-year, 5-year and 10-year sectors respectively. The rise in German yields explains most of the spreads' tightening in Spain, Italy and Ireland. Actually, it means that e.g. in Ireland the yields even increased marginally. My conclusion is that even though the first impression would support the view that a higher than expected repayment amount was perceived to reflect improved bank funding positions because the spreads tightened, this conclusion might be rather unsound as the narrowing spreads were mostly a product of rising German yields.

The fifth event captures the market response to a lower than expected repayment of the second LTRO in February 2013. The spreads should widen if a lower amount was interpreted as reflecting unchanged or even deteriorated bank funding positions. However, the results in Table 3 show mixed results. The spreads widened in Ireland marginally but narrowed in Italy by a few basis points. The changes in Portugal and Greece are not statistically significant and the results in Spain are ambiguous. Overall, the changes are quite small considering the high volatility.

Again, it is necessary to control for other market movers. First of all, on the fifth event date, similarly to the fourth event date, the German IFO index was again released. Indeed, also this time it showed a significant improvement in German business climate. However, the positive IFO surprise could have been at least partially offset by the release of European Commission (EC) economic forecasts that surprised on the downside. Both the IFO index and the EC forecasts should be reflected in the price moves of German bonds, as these bonds are considered to be the European benchmark. They should reflect expectations on future interest rates in a way that an improvement in economic growth expectations should drive the yields higher whereas growth woes should push the yields down. On the day, the German yields dropped 4, 2 and 1 basis points in maturities of 2, 5 and 10 years. Thus, I conclude that the EC forecasts offset the positive effect from the IFO index and the ultimate market sentiment was rather negative. Risk aversion, in turn, should have resulted in widening spreads of distressed sovereigns. In other words, because the prevailing negative market sentiment ought to have magnified the reaction suggested by the alternative hypothesis and the spreads should have increased. However, as the results are mixed, I conclude that the null hypothesis holds and the market participants did not interpret the lower than expected repayment amount to reflect the state of banks' funding positions.

To summarize the results of the first event study, I conclude that the 3-year LTRO announcements mostly fell short of the desired market outcome. The operations were part of the enhanced credit support i.e. they had a goal of supporting the monetary policy transmission mechanism. The measures were designed to ensure enhanced access of the banking sector to liquidity and facilitate the functioning of the euro area money market. The measures were also expected to support the provision of credit to households and non-financial corporations. In this context, also the reaction of the sovereign bond market was crucial as the bond market distress was a major cause of funding fragmentation in the euro area.

The first announcement was upstaged by the political debate in the euro area as the leaders were negotiating about the fiscal compact. The first LTRO allotment was shadowed by the market participants' inability to decide whether the facility should be exploited or whether there was stigma relating to its use. Only the second LTRO allotment had a clearly positive impact and it even overshadowed the Greek woes that were very acute at the time. An important question is whether the different response to the second allotment was thanks to the ECB encouraging the banks to participate which is likely to have alleviated stigmatization. Anyway, an overall muted or negative

reaction could reflect that, at the time, the market participants were indeed expecting more aggressive measures from the ECB. As a reminder, the ECB had conducted longer-term liquidity operations before even if not in three year maturities. Furthermore, the event study regarding the repayment announcements showed a similar ambiguity than the study on allotments. Again, the results showed that the market participants were quite confused how they should interpret the repayment amounts. Both of these results implicate that a central bank's guidance on what it aims to achieve with its instruments is crucial.

5.2 Outright monetary transactions

The results of the event study analysis described in Section 4.3 are summarized in Table 5. The panel reports the change in sovereign bond spreads across the event window for each announcement. Below, Table 6 reports the standard deviations and the average changes over the time period under review. It shows that the Greek bonds have been the most volatile followed by Portugal and Ireland. The Italian and Spanish sovereign bonds have experienced roughly the same volatility. Interestingly, a comparison of Table 4 and Table 6 reveals that observing a longer time period shows an increase in volatility of the spreads. One-day standard deviations are higher for nearly all the sovereigns under study. Indeed, the volatility only abated somewhat in Ireland and marginally in Italy. Overall, the comparison demonstrates that the time period between the data cut-off point of the first study and the data cut-off point of the second study, i.e. the time period from December 2011 until July 2012, was extremely volatile. Finally, Table 7 presents a snapshot on the closing levels of the bond spreads for each event day.

Table 5 Changes in sovereign bond spreads in event windows in basis points. A dark cell denotes a change to the opposite direction of the alternative hypothesis forecast.

Changes in sovereign bond spreads versus Germany (bps)			
	Spain 2yr	**Spain 5yr**	**Spain 10yr**
26.7.2012	-75**	-66**	-51**
2.8.2012	-9**	30**	57**
6.9.2012	-18**	-52**	-71**
	Italy 2yr	**Italy 5yr**	**Italy 10yr**
26.7.2012	-89**	-65**	-45**
2.8.2012	-1	34**	54**
6.9.2012	-17**	-52**	-58**
	Portugal 2yr	**Portugal 5yr**	**Portugal 10yr**
26.7.2012	49**	16**	-17**
2.8.2012	16**	-2	11**
6.9.2012	-13**	-82**	-47**
	Ireland 2yr	**Ireland 2yr**	**Ireland 10yr**
26.7.2012	-39**	-10**	
2.8.2012	4*	11**	
6.9.2012	-31**	-46**	
	Greece 2yr	**Greece 5yr**	**Greece 10yr**
26.7.2012			-12**
2.8.2012			-23**
6.9.2012			-35**
Note: 6.9. changes are for a two-day window (5.9.-6.9.)			
*indicates that the change is statistically significant with a 95 % confidence level			
**indicates that the change is statistically significant with a 99 % confidence level			

Table 6 Average changes in bond spreads and standard deviations.
The data is collected from 1.1.2010 until the day before the first event (25.7.2012).

	Spain 2yr	**Spain 5yr**	**Spain 10yr**
1-day average chg (bps)	0.9	0.9	0.5
1-day standard dev. (bps)	16.3	15.2	10.6
2-day average chg (bps)	1.3	1.6	0.9
2-day standard dev. (bps)	26.6	24.1	17.0
	Italy 2yr	**Italy 5yr**	**Italy 10yr**
1-day average chg (bps)	0.5	0.5	0.3
1-day standard dev. (bps)	16.2	13.4	10.1
2-day average chg (bps)	0.6	0.8	0.6
2-day standard dev. (bps)	25.7	21.2	15.6
	Portugal 2yr	**Portugal 5yr**	**Portugal 10yr**
1-day average chg (bps)	1.0	1.2	1.1
1-day standard dev. (bps)	51.0	36.3	24.7
2-day average chg (bps)	2.0	2.2	2.1
2-day standard dev. (bps)	77.7	56.4	37.8
	Ireland 2yr	**Ireland 2yr**	**Ireland 10yr**
1-day average chg (bps)	0.3	0.3	
1-day standard dev. (bps)	40.0	28.4	
2-day average chg (bps)	0.5	0.7	
2-day standard dev. (bps)	62.7	41.8	
	Greece 2yr	**Greece 5yr**	**Greece 10yr**
1-day average chg (bps)			3.3
1-day standard dev. (bps)			85.2
2-day average chg (bps)			6.1
2-day standard dev. (bps)			122.1

Table 7 Sovereign spreads were on a narrowing trend after the first event.

Snapshots on bond spreads versus Germany (%-points)			
	Spain 2yr	**Spain 5yr**	**Spain 10yr**
26.7.2012	5.7	6.2	5.6
2.8.2012	4.9	6.1	5.9
6.9.2012	2.9	4.1	4.5
	Italy 2yr	**Italy 5yr**	**Italy 10yr**
26.7.2012	4.1	5.2	4.7
2.8.2012	3.8	5.3	5.1
6.9.2012	2.2	3.5	3.7
	Portugal 2yr	**Portugal 5yr**	**Portugal 10yr**
26.7.2012	8.6	10.7	10.0
2.8.2012	8.2	10.2	9.8
6.9.2012	4.6	5.9	7.2
	Ireland 2yr	**Ireland 2yr**	**Ireland 10yr**
26.7.2012	3.8	5.0	
2.8.2012	3.6	5.5	
6.9.2012	2.2	4.3	
	Greece 2yr	**Greece 5yr**	**Greece 10yr**
26.7.2012			26.3
2.8.2012			24.6
6.9.2012			20.2

Of the three events in Table 5, the most remarkable event is the first one i.e. Draghi's speech in London and his promise to do "whatever it takes" to preserve the euro. As the table shows, the event had the largest impact on the bond spreads of Italy and Spain. Furthermore, the effect was more significant in the short end of the yield curve. Indeed, the Italian 2-year spread narrowed nearly 90 bps whereas the Spanish counterpart tightened 75 bps. Interestingly, the first event did not have as remarkable impact on Portuguese spreads whereas the impact on the short end of the Irish curve was quite considerable. The impact on Greek ten-year spread was fairly small yet statistically significant.

Regarding the daily changes for the *first event*, it is important to take note of other potential market moving events on the event day. Indeed, the soft reaction in Portuguese, Irish and Greek bonds could be partially explained by the fact that on the very same day, there was some media speculation about a possible Greek euro exit and the bailout program running off-track. Even if Draghi's afternoon promise was taken seriously and fears of a Greek euro exit should have abated, expectations on a massive central bank intervention could not solve the issue of the EU/IMF program running off-track and the sovereign perhaps needing more funding, which could explain the relative underperformance of Greek bonds on the event day. The faint reaction in Portugal and Ireland in comparison to Italy and Spain could also be partially explained by these news and contagion fears.

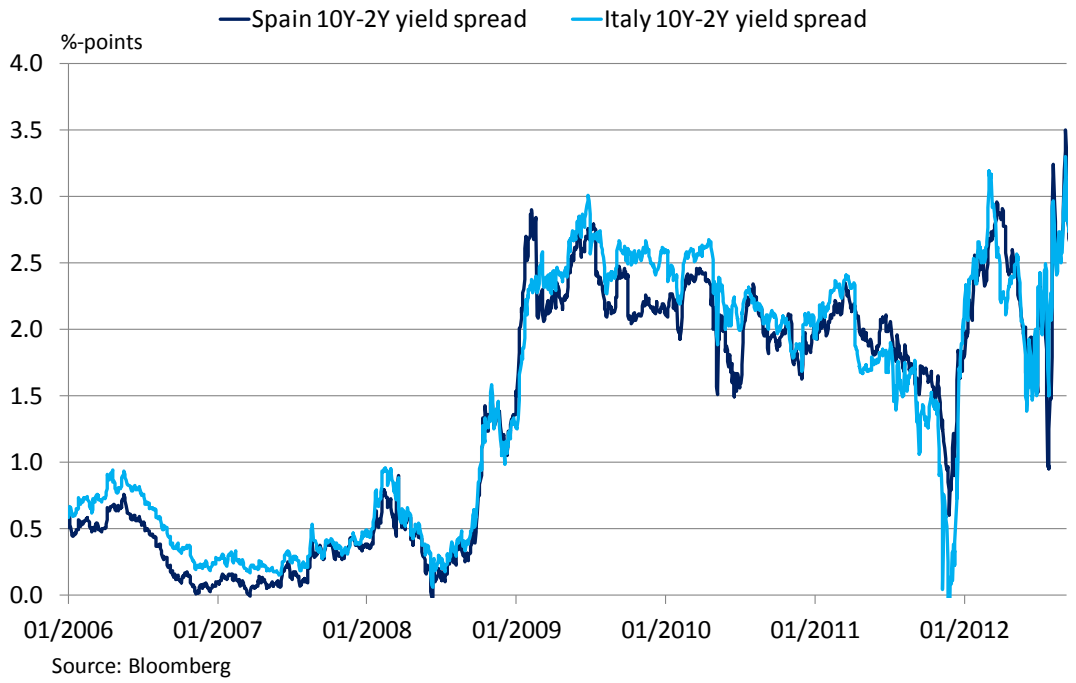
On the other hand, Draghi's speech was not the only positive market moving event on 26th of July. There were a few data releases from the US that gave further boost to the positive market sentiment. Namely, the release of durable goods data and the weekly jobless claims, that both came in better than expected. However, as these data releases were focused in the US economy, I conclude that their effect on euro area sovereign spreads should have been rather marginal even if they boosted the general risk appetite. There was also an Italian auction on the same day but since the results were considered to be fairly average, I believe it is safe to assume that it did not have significant effect on spreads. Thus, my conclusion is that the results in Italy and Spain adequately reflect the reactions to Draghi's speech.

The markets were rather disappointed with the *second event*, as Table 5 shows. In longer maturities (5Y-10Y), the alternative hypothesis needs to be rejected for all countries except for Greece. In addition to Portuguese and Greek spreads, only the change in Spanish two-year spread is

statistically significant and in line with the alternative hypothesis. The overall muted or negative reaction is even more remarkable considering there was a Spanish auction on the same day which, according to market participants, went quite well. Regarding the ECB announcement, the media reports show that the markets were disappointed with the lack of details and immediate action (BBC, 2012). It is worth mentioning, however, that the Italian and Spanish spreads had tightened quite significantly between the first and the second event. This development is shown in Table 7. Also, the spreads continued to narrow on the days following the second event which might reflect that the markets just needed some time to digest the news. However, as my study focuses on the announcement effect, I have to conclude that the second event was not very effective when it comes to immediate market reactions.

The *third event*, the announcement on the details of the OMT, was the only event in which the null hypothesis needs to be rejected for all the variables under review. In this event window, the spreads tightened more in the longer maturities, which is interesting since the unveiled technical modalities of the OMT indeed showed that the program would concentrate on maturities from one to three years. However, looking at Table 7 shows that the short end spreads had narrowed massively after the first event so, which could indicate that there was not so much room for further narrowing in the short end. For example, the Spanish 2-year spread had more than halved and the Italian 2-year had also nearly halved during the roughly five week's time between the first and the third event. Indeed, the yield curves had steepened to historical levels before the OMT announcement as the bonds with shorter maturity had rallied in expectations of an ECB intervention. Figure 17 illustrates the steepness of Spanish and Italian yield curves. The data cut-off point is the 5th September 2012.

Figure 17 Yield curve steepness in Spain and Italy.



Due to a leak of OMT modalities on 5th of September, I have studied a two-day event window (5.-6.9.2012). Thus, before celebrating the significant narrowing in bond spreads I need to control for other potential market movers in the event window. On September 5th, on economic data front, the purchasing manager indexes (PMIs) from euro area countries' service sector were published[32]. There were some positive surprises such as Italy but overall the figures were disappointing. Most importantly, the aggregate figure from euro area was lower than the market analysts had expected. Otherwise, there were no major data or news releases other than the OMT leak on Bloomberg.

On September 6th, there was a Spanish auction that was extremely well received in the market and further added to the positive market sentiment. However, it is obvious that the mounting ECB expectations and the OMT leak on the previous day provided the Spanish treasury with very fertile conditions for the auction. Thus, even though the causality between the auction and the prevailing positive market sentiment is not studied here, I believe it is safe to assume that the ECB expectations were the main driver and a good auction was a corollary. Furthermore, on that day, there were some US data releases that surprised the market on the upside. These included the ADP employment report, weekly jobless claims and the service sector ISM index. However, as these

[32] PMIs reflect the businesses' economic optimism.

releases were US-related I assume that their effect on the euro area peripherals was negligible. Hence, I conclude that the OMT announcement was the driver that explained the narrowing of the spreads in the third event window.

To summarize the results of the study on OMT announcement effects, I conclude that the first event and the third event were the most significant whereas the second event was not that significant. Furthermore, I conclude that the first event had even larger effects than the third one. This opinion is based on the fact that Italian and Spanish bonds, which had been in the market spotlight during the summer, rallied the most after the first event. Regarding the market fears of a euro area break-up, I believe that Italy and Spain were in the most crucial position. The other three countries had already received bailout packages whereas Italy and Spain were still struggling without. Both were under severe market pressure and the EMU was, at least in the eyes of market participants, close to reaching a breaking point. Thus, in my opinion, the effectiveness of the OMT should primarily be evaluated with respect to its effects on Italian and Spanish spreads which would make the first event the most remarkable. The major impact of the first event underlines the significance of communication as the first event was purely a promise without any technical details or actual central bank decisions. Indeed, whether words sometimes speak louder than action is a question I will return to in the next section.

6 Discussion

Thus far, I have explained the rationale for a central bank to conduct unconventional monetary policy and presented the most common policy options. In Chapter 1, I discussed the shortcomings of conventional monetary policy and explained how unconventional response may be needed when the economy is heading towards a “bad” equilibrium. Furthermore, I discussed how unconventional measures can also be taken in response to problems in monetary policy transmission. I presented the different transmission channels and mentioned how many of these channels were impaired during the crisis. In Chapters 2 and 3, I discussed the measures conducted by the ECB focusing on their response to the euro area sovereign debt crisis. In Chapters 4 and 5, I laid out the framework for an empirical study and evaluated the market reactions to announcements by the ECB on special-term liquidity provision and outright monetary transactions. In this chapter, I will evaluate the effectiveness and justification of the ECB’s crisis response in light of the theory discussed above.

Also, I will point out some risks related to unconventional monetary policy as well as provide some ideas for further study.

Most of the ECB's unconventional measures have been justified by the need to support monetary policy transmission. Indeed, as presented in Section 3.1.3, the enhanced credit support policy was designed to enhance the flow of credit beyond what could be achieved with conventional rate cuts. Thus, the ECB's policy was explicitly targeted to support monetary policy transmission and, more precisely, the credit channel especially through bank lending. For example Cour-Thimann and Winkler (2013) argue that the ECB's response has been different from other major central banks that have conducted outright purchases to target asset prices. However, the authors claim that the ECB's credit support measures have also indirectly supported asset valuation.

Not all the measures conducted by the ECB have been explicitly labeled as enhanced credit support. As discussed in Chapter 3, measures related to liquidity provision, namely the extension of refinancing maturities and eligible collateral framework as well as the flexibility of liquidity provision in the form of full allotment procedure were categorized as enhanced credit support. Also, the covered bond purchase programs fell into the same category. However, the SMP was not categorized as enhanced credit support neither was the OMT. The first one was designed to ensure adequate depth and liquidity in dysfunctional market segments and the latter was designed to remove risk premiums on the sovereign bond market that reflected redenomination risks and unfounded fears of a country leaving the euro. The ECB acted because the price distortions were hampering the monetary policy transmission and endangering the ultimate goal of monetary policy, the price stability. My interpretation is that these measures were primarily targeting the asset price channel whereas other channels were perhaps indirectly affected.

Obviously, the ECB has also exploited the interest rate channel to the utmost as it has cut the policy rates to historical lows. As the ECB, in several occasions during the crisis, responded by conducting unconventional measures, its policy rates have only recently approached the zero lower bound. Simultaneously, as the economic growth in the euro area has been dampened as a result of the debt crisis and the inevitable deleveraging both in the public and in the private sector, disinflationary expectations have been starting to mount. Thus, perhaps for the first time during the sovereign debt crisis, the ECB is facing a real threat of a deflationary spiral. These developments prompted the ECB, for the first time, to announce forward guidance on its future interest rate policy. As discussed

in Section 3.2.6, the ECB's expectation to keep the policy rates low for an extended period of time was based on the overall subdued outlook for inflation in the medium-term. This measure was clearly designed to further support the interest rate channel but also to exploit the signaling channel.

Indeed, the signaling channel has probably been the most useful intermediary channel for the ECB's policy. As my study on the announcement effects of the OMT showed, a credible commitment can have massive effects. The ECB's commitment to do 'whatever it takes' to preserve the euro had remarkable effects on the sovereign bond spreads. The effects were significantly larger than any other measures up to that point. Neither the SMP nor the 3-year LTROs had succeeded in alleviating the tensions in the European sovereign bond market as quickly and effectively as the OMT announcement did. It is evident that the effectiveness of the OMT comes from the signaling effect as no purchases have been conducted under the program. It might even be justified to claim that when the financial markets are questioning the central bank's backstop role, words may sometimes speak louder than action.

To evaluate whether the ECB's measures have been effective overall, it is useful to assess whether there are signs of the transmission mechanism functioning better and whether the inflation expectations are anchored. As discussed above, the enhanced credit support has been a key building block of the ECB's crisis response. It seems that the euro area has, at least for now, avoided a major credit crunch and the bank lending surveys have provided indications of further stabilization. However, the monetary dynamics still remain subdued. The latest statements by the president of the ECB confirm this (ECB2014). The ECB's credit supportive liquidity measures have probably helped to prevent a credit crunch and will potentially continue to be deployed for some time to come as the data still shows that the credit channel is not functioning properly.

An issue that has been raised regarding the central bank's massive liquidity provision is the fear of the banking system becoming more and more dependent on central bank refinancing. Indeed, during the crisis, the ECB stepped up to replace the interbank market and became, at times, almost the sole provider of liquidity for the banks. The generous liquidity provision has been feared to promote moral hazard, prolong the necessary deleveraging process and give artificial respiration to banks that ought to be wound down. Furthermore, it has been feared to feed the unhealthy feedback loop between the banks and their respective sovereigns. The public has also been worried about

excessive central bank risk-taking as, in the end, should a central bank need more capital was the government to step in using the taxpayers' money.

The central banks have responded to the last criticism by making provisions and building risk buffers on their balance sheets. In addition, at least some of the other woes are now being addressed at the European level. Namely, the ECB is taking over the supervisory tasks of the largest banks in Europe in the course of 2014. Before that, the ECB is conducting an asset quality review for the most important European banks. Furthermore, the European Banking Authority is running stress tests for the European banks. In addition to the Single Supervisory Mechanism (SSM), the European politicians are preparing the Single Resolution Mechanism (SRM) to agree on a common framework for a wind-down of insolvent banks.

With respect to the asset price channel, the ECB's measures have either directly or indirectly supported asset valuation, especially in the sovereign bond market. The bond spreads no longer constitute the main worry for the ECB when it evaluates monetary policy transmission. However, the outstanding performance of peripheral bonds in the course of the second half of 2012 and 2013 has prompted doubts about the economic justification for the low level of spreads. Indeed, some peripheral bond yields are significantly lower than was evaluated as a "fair" level in 2012, before the OMT was announced. Investment bank estimates, at the time, considered that Italian and Spanish 2-year yields incorporated convertibility premiums of 2.0 percentage points and 0.90 percentage points (BusinessInsider, 2012). However, since this analysis was released, the 2-year yields have dropped nearly 3 percentage points in Spain and close to 2 percentage points in Italy. Even though these developments may also be partially explained by improvements in fundamentals, they nevertheless pose a question of whether the central bank policies have led to adverse price distortions. In addition, the strong performance of equities has raised doubts of overvaluation and bubbles developing due to generous liquidity provision. Indeed, an evaluation of whether unconventional central bank policies have led to price bubbles and distortions should be studied further. Moreover, there is no sufficient research on the fair level of European sovereign bond yields and the estimates are extremely sensitive to assumptions on different parameters.

As the ECB's measures have been acknowledged to address problems in the functioning of the credit channel and as it has even met some criticism related to supporting overvaluation of some assets, simultaneously, there has been a growing concern about to what extent is the European

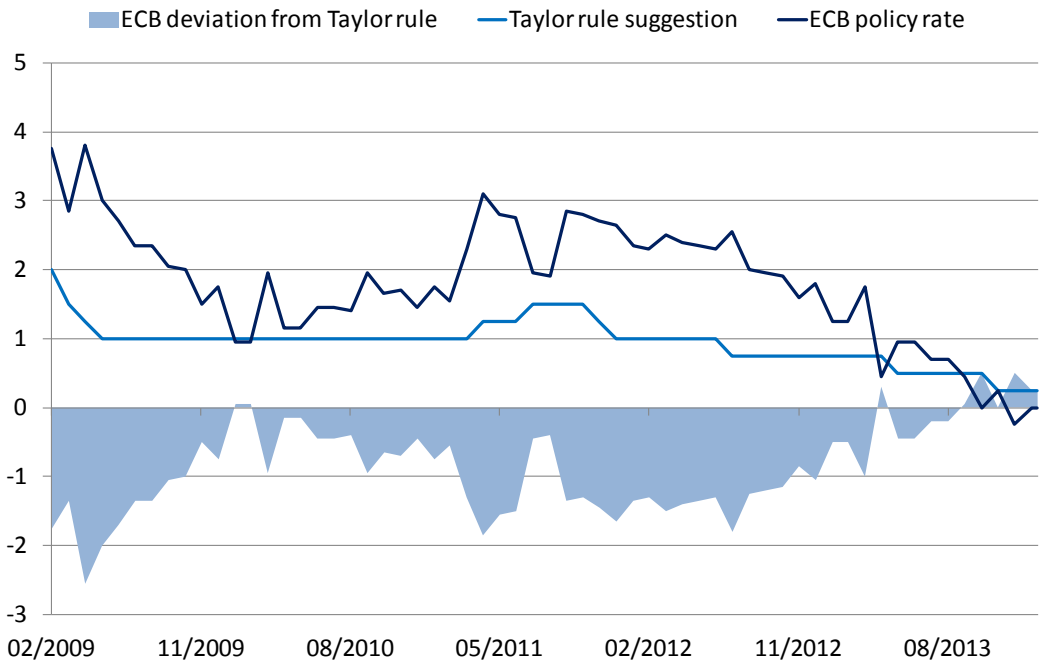
economic growth further dampened due to an allegedly strong euro. The exchange rate channel has not been targeted by the ECB measures, at least not directly or explicitly. The ECB or its representatives have occasionally pointed out that the exchange rate is not a policy target for the ECB and that the central bank will only pay attention to exchange rate issues up to the point that they affect on the price stability, see e.g. Draghi's introductory statement from October 2013 (ECB2013c). Naturally, the euro exchange rate has nevertheless been affected when the ECB has conducted measures that have targeted supporting the transmission mechanism via another channel. An interesting research topic would be whether and to what extent have unconventional central bank policies explained exchange rate developments during the financial and sovereign debt crises.

From the point of view of a liquidity trap and the threat of an economy surging into a deflationary spiral, the ECB has only recently faced severe challenges. The euro area headline inflation dropped significantly when the financial crisis hit and during 2009 the euro area was in deflation for a few months time. However, in 2010 the upward price pressures built up fairly quickly and during the worst turbulence of the sovereign debt crisis, the headline inflation remained above the ECB's target of 'close but below 2 percent'. The picture has changed gradually since then as e.g. the ongoing deleveraging process and the subdued economic activity have contributed to lower price pressures. Indeed, as the market and public focus has shifted away from the sovereign bond market distress, fears of a prolonged period of low inflation or even deflation have accelerated.

A simple Taylor rule application for the euro area is illustrated in Figure 18. Calculations in the figure assume coefficients for inflation gap at 1.5 and for output gap at 0.5. Moreover, they assume a neutral rate of interest at 2 % and apply the core HICP figure (0.8 %) for the euro area from January 2014. The inflation target is assumed to be 2 % and the output gap -2 %[33]. The figure shows that only recently the inflation and output gaps in the euro area have suggested negative policy rates. It needs to be said, however, that the calculations are very sensitive to changes in different parameters. Indeed, minor changes in parameters would suggest a negative rate significantly earlier, already in 2013.

[33] The output gap is calculated as an average for a period of 2009-2013 using IMF World Economic Outlook data (IMF, World Economic Outlook Database).

Figure 18 Applying the Taylor rule would suggest implementing negative policy rates. The analysis is quite sensitive to assumptions on neutral real rate of interest and the output gap as well as to different coefficients (Source: IMF, World Economic Outlook).



The ECB has not responded to disinflationary pressures with a rate cut to the negative territory and it even has some maneouvre left in its main refinancing rate which is currently at 0.25 %. Instead, the ECB has implemented another policy measure, forward guidance, which is often regarded as one of the most applicable tools to escape or avoid a liquidity trap. The ECB's forward guidance has been fairly well received in the market and analysts have showed an increasing support for it. However, due to the novelty of the policy in the ECB toolkit, there is no academic research on the effects of the ECB's forward guidance. As the previous studies[34] evaluating the effectiveness of forward guidance have shown encouraging results, it can be concluded that the ECB was in a position where giving forward guidance was justified and, perhaps, even crucial in order to avoid tightening in the money market at a time when inflation expectations were very low. It remains to be seen whether the ECB will need to resort to further measures to avoid a deflationary spiral and a liquidity trap. Recently, there have been calls in the media and, to some extent, in the market for the ECB to enter into quantitative easing by conducting outright government bond purchases. However, the efficacy of QE policies in fighting against deflationary pressures has not been approved. For

[34] (Eggertsson & Woodford, 2003) and (Gürkaynak;Sack;& Swanson, 2005)

example Eggertson (2003) concludes that forward guidance might be more effective a policy at the zero lower bound than quantitative easing.

Even though deflationary or disinflationary risks have been a popular topic lately, there have also been voices, during the crisis, criticizing the ECB and other central banks that the unconventional measures will create inflationary pressures and risk price stability. As the financial crisis and the sovereign debt crisis have both prompted unparalleled responses from all major central banks, the scholars are only starting to evaluate whether some of these measures have actually jeopardized the central banks' mandates and their ultimate goals.

Indeed, what drove the major central banks towards greater independence in the course of 20th century was the fact that diversified roles of central banks had been realized to have created inflation. During the "golden age" of central banking, the central banks pursued greater independence and disentangling themselves from the leash of the fiscal authority. (Stone, Fujita, & Ishi, 2011) However, the central banks' crisis response, also that of the ECB, has since then provoked questions of whether the independence of the central banks is again threatened. For example Kaarlo and Klaus Tuori (2014) have studied the euro area crisis from a constitutional point of view. Their main thoughts are that many presumptions for the monetary union were misplaced and the ECB's role is complicated from the constitutional viewpoint. Furthermore, their conclusion is that during the crisis, some of the clauses of the Lisbon Treaty, such as the so-called "no-bailout" clause, have been interpreted very loosely[35]. As a result, the authors see narrowing of fiscal sovereignty which might compromise the democratic legitimacy. In addition, they also see the large scale asset purchases and the supervisory role of the central bank possibly compromising the constitution. Whereas the first criticism targets the EU decision-making and the bailout packages, the latter clearly targets the central banks.

The issues relating to the ECB independence have even been brought to court. In early 2014, and the German Constitutional Court announced its ruling over the ECB's OMT program. One of the

[35] The so-called "no-bailout" clause, Article 125 in the Lisbon Treaty, says that the EU shall not be liable for or assume the commitments of central governments (The Lisbon Treaty).

key issues was whether the OMT violates the Article 123 of the Lisbon Treaty[36]. The German Constitutional Court concluded that there were important reasons to assume that the OMT would exceed the European Central Bank's monetary policy mandate and thus infringe the powers of the Member States, and that it would violate the prohibition of monetary financing of the budget (The Federal Constitutional Court, 2014). However, the final decision on legitimacy was transferred to the European Court of Justice. During the spring 2014, the German Constitutional Court will yet pronounce its judgment over the legitimacy of the ESM.

The ECB has responded to the criticism towards the legitimacy of its actions in several occasions. The main argument defending the ECB's stance is that none of its government purchase programs have the feature of the ECB buying debt directly from the issuer. As the central bank only operates in the secondary market, a sovereign issuing new debt needs to find investors in the primary market other than the central bank. Further aspects have been pointed out by the ECB Executive Board member Benoit Coeure (2013). He claims that the OMT program is robust because, first of all, it is implemented with strict conditionality i.e. the countries need to respect their macroeconomic adjustment programs in order to be eligible for the OMT. Secondly, according to Coeure, the OMT would never be used to indiscriminately push down government bond spreads instead it would only target the portion of spreads that is not fundamentally justified.

The discussion about the ECB's independence is likely to continue as the evidence of the effectiveness of its measures is further assessed and as the European crisis response as a whole, the ECB measures and the EU measures, is further scrutinized. Discussion about a possible violation of the mandate will probably also feature thoughts of a potentially broader mandate. Indeed, some have already suggested that the ECB ought to broaden its mandate as the economic activity remains stubbornly sluggish. The Federal Reserve, for example, has a dual mandate of maintaining price stability as well as promoting maximum employment.

Regarding the discussion on mandates, Honkapohja and Mitra (2014) have recently compared the dynamics of nominal GDP targeting and inflation targeting. They find that the performance of either price-level targeting or nominal GDP targeting is on the whole better than that of inflation

[36] Article 123 in the Lisbon Treaty says that Overdraft facilities or any other type of credit facility with the European Central Bank or with the central banks of the Member States central governments shall be prohibited, as shall the purchase directly from them by the European Central Bank or national central banks of debt instruments.

targeting. However, the results are sensitive to agents' ability to incorporate the guidance under the new policy rule. If private agents have not fully incorporated the new guidance, the results are not that clear-cut. Thus, even though the results are promising and support the policy rule of nominal GDP targeting, they suggest that a change in policy rule may often lead to uncertainty and problems in communication as it will take time before the public has learned the new reaction function of the central bank. The discussion and evaluation of mandates and different policy rules is likely to develop in years to come as the scholars are able to better assess the measures that were taken during the crisis.

However, even if future studies were to find that there have been adverse effects and that unconventional monetary policy measures had, at least to some extent, contributed to a central bank losing some control over its ultimate target of price stability, it might be impossible to compare the cost of these adverse effects to the payoff of the unconventional measures. What makes the evaluation even more difficult is that the counterfactual is not known. The conditions in which the central banks resorted to unconventional measures were as unparalleled as the measures per se and, thus, it is impossible to know what the world would look like without these measures.

7 Conclusions

The financial crisis that started in 2007 as a sub-prime mortgage crisis in the US and led to a sovereign debt crisis in Europe has been a serious trial for major central banks. The financial market turbulence and the deep global recession prompted measures from central banks that were unprecedented in terms of scope, magnitude and intensity. Even though global cooperation was needed, most measures were tailor-made to address the unique features and characteristics of the market structures in each currency area. The ECB first responded with its enhanced credit support policy that focused on supporting the monetary policy transmission via the banking system. As the crisis continued and escalated, the ECB gradually added new tools to its unconventional first-aid kit.

Within the *enhanced credit support* policy, the ECB provided liquidity to the banking system in a more flexible manner than before. It provided liquidity in unlimited amounts on a fixed rate against a wider range of eligible collateral and in longer maturities than ever before. As a part of the global cooperation plan, the ECB also provided liquidity in some foreign currencies. As the liquidity

provision alone was not enough to secure the transmission of monetary policy, the ECB also conducted outright asset purchases in the credit market. Furthermore, it addressed the tensions in the sovereign bond market with its SMP program. Regarding the developments in the sovereign bond market, though, none of the measures above compare to the effects of the OMT announcement. As the event studies show, the initial sovereign bond market reaction to 3-year LTROs was rather muted, even negative, whereas the OMT had immediate and positive effects on the sovereign bond spreads without the central bank conducting a single purchase.

Indeed, the OMT's success shows that a credible central bank backstop is needed in a financial crisis. Before the OMT was announced, even the viability of the common currency was questioned. The ECB, being a fairly "young" central bank, did not perhaps have the authority of a true lender of last resort or an ultimate backstop for the banking system in the eyes of the market participants. It explains why a mere promise from the president of the ECB to do "whatever it takes" to preserve the euro had such massive effects that e.g. Spanish and Italian bond spreads narrowed 50-100 bps immediately. In that particular case, words actually spoke louder than action. Indeed, Draghi's words and the OMT announcements as a whole can easily be graded as one of the most effective central bank measures during the crisis. The OMT has definitely bought precious time for the distressed sovereigns to continue their fiscal adjustment processes. The future will show whether that time was enough.

Currently, the emphasis of the crisis has shifted from the sovereign bond market to the weakness in the real economy, and the ECB is encountering a new communication challenge as the money markets have occasionally tightened despite of ample liquidity and low policy rates. As a response to the subdued medium-term outlook for inflation and an unwarranted rise in money market rates, the ECB pronounced that it expects its policy rates to remain at present or lower levels for an extended period of time. This is a remarkable change in rhetoric for a central bank that previously emphasized how it "never pre-commits". The new approach is a sign that the ECB is taking the threat of a prolonged period of low inflation very seriously. Indeed, studies have shown that communication in the form of forward guidance can be the most effective weapon to fight disinflationary pressures and escape or avoid a liquidity trap. The future will show whether further measures need to be taken to keep inflation expectations anchored.

The debate about the effectiveness as well as the legitimacy of the ECB's measures will undoubtedly continue for many years to come as more scholars will add their contributions to the assessment of measures that were taken to respond to an unprecedented financial crisis in the euro area. There is a debate about whether some of the ECB measures are promoting asset price bubbles. Also, some are worried that the banks are becoming more and more dependent on central bank refinancing. Moreover, the ECB is countering a loud criticism from those who see the unconventional measures as jeopardizing its independence.

Simultaneously, however, some are calling for more aggressive measures as the European economy is potentially facing a prolonged period of low inflation. Indeed, the European central bankers are perhaps stepping into what might be a new phase of the prolonged crisis - the markets have stabilized but the inflation is lagging behind the ECB's target. In a sense, the ECB is between a rock and a hard place as it needs to respond to the public criticism but also be ready to act again if needed, perhaps with even more aggressive measures. However, the lessons learned during the crisis will undoubtedly be of great support in the policymakers' upcoming endeavours. Moreover, as the central bank working field is set to become more diverse and the concept of operational target more ambiguous, the engine room crew will surely have their say also in the design of potential future measures.

List of references

Baba, N., & Shim, I. (2010, June). Policy responses to dislocations in the FX swap market: the experience of Korea. *BIS Quarterly Review* , pp. 29-39.

BBC. (2012, August 2). Eurozone crisis: ECB's Draghi disappoints markets. Retrieved February 4, 2014, from http://www.bbc.co.uk/news/business-19096371

Bernanke, B. S. (2009, January 13). The Crisis and the Policy Response. London, England: Federal Reserve.

Bindseil, U. (2004, June). The Operational Target of Monetary Policy ad the Rise and Fall of Reserve Position Doctrine. *ECB Working Paper Series , 372*.

Bindseil, U. (2011). Theory of Monetary Policy Implementation. In P. Mercier, & F. Papadia, *The Concrete Euro* (pp. 5-107). New York: Oxford University Press.

Bindseil, U., & Jablecki, J. (2013, May). Central Bank Liquidity Provision, Risk-taking and Economic Efficiency. *ECB Working Paper Series , 1542*.

Blinder, A. S., Ehrmann, M., Fratzscher, M., De Haan, J., & Jansen, D.-J. (2008). Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence. *ECB Working Paper Series , 898*.

Bloomberg. (2011, December 7). ECB Officials Said to Plan Additional Measures to Stimulate Bank Lending. *Bloomberg* . Retrieved January 29, 2014, from http://www.bloomberg.com/news/2011-12-07/ecb-officials-said-to-plan-additional-measures-to-stimulate-bank-lending.html

Bloomberg. (2012, September 5). ECB Plan Said to Pledge Unlimited, Sterilized Bond-Buying. Retrieved December 21, 2013, from http://www.bloomberg.com/news/2012-09-05/ecb-plan-said-to-pledge-unlimited-sterilized-bond-buying.html

BOE. (n.d.). *Asset Purchase Facility - Results*. Retrieved May 4, 2013, from Bank of England: http://www.bankofengland.co.uk/markets/Pages/apf/results.aspx

BOJ. (2001, March 19). *Bank of Japan Announcements.* Retrieved May 4, 2013, from Bank of Japan: https://www.boj.or.jp/en/announcements/release_2001/k010319a.htm/#betsu

BOJ. (2013, 25 March). *Bank of Japan Statistics.* Retrieved May 5, 2013, from http://www.boj.or.jp/en/statistics/sj/

BOJ. (2013, April 4). Introduction of the "Quantitative and Qualitative Monetary Easing". *Guideline for Money Market Operations* . Bank of Japan.

Borio, C. (2001, December 01). A hundrer ways to skin a cat: comparing monetary policy operating procedures in the United States, Japan and the euro area. *BIS Working Paper Series* .

Borio, C., & Disyatat, P. (2009). Unconventional Monetary Policies: an Appraisal. *BIS Working Papers , 292*.

BusinessInsider. (2012, September 2). JPMorgan Estimates What Yield Levels The ECB Might Target On Spanish And Italian Bonds. *Business Insider* . Retrieved February 17, 2014, from http://www.businessinsider.com/jpmorgan-estimates-what-yield-levels-the-ecb-might-target-on-spanish-and-italian-bonds-2012-9

Campbell, J., Evans, C., Fisher, J., & Justiniano, A. (2012). Macroeconomic Effects of Federal Reserve Forward Guidance. *Brookings Papers on Economic Activity* .

Cecioni, M., Ferrero, G., & Secchi, A. (2011). Unconventional Monetary Policy in Theory and in Practice. *Questioni di Economia e Finanza (Occasional Papers) , 102*.

Coeure, B. (2013, September 2). Outright monetary transactions, one year on. Berlin, Germany: BIS.

Cour-Thimann, P., & Winkler, B. (2013, April). The ECB's non-standard monetary policy measures - the role of institutional factors and financial structure. *ECB Working Paper Series , 1528*.

Cox, J. C., Ingersoll, J. E., JR., & Ross, S. A. (1985). A Theory of the Term Structure of Interest Rates. *Econometrica , 53* (2).

Draghi, M. (2012, July 26). Verbatim of the remarks made by Mario Draghi. London, UK.

ECB. (2013, October 17). *ELA Procedures.* Retrieved November 16, 2013, from www.ecb.europa.eu: http://www.ecb.europa.eu/pub/pdf/other/elaprocedures.en.pdf?e0e0688fa82a174563d3cc838d7f5de1

ECB. (2010, June). *Monthly Report on the Eurosystem's covered bond purchase programme*. Retrieved October 6, 2013, from http://www.ecb.europa.eu/pub/pdf/other/monthlyreporteurosystemcoveredbondpurchaseprogramme201007en.pdf

ECB. (2011, December 21). *Open market operations*. Retrieved January 29, 2014, from http://www.ecb.europa.eu/mopo/implement/omo/html/20110149_all.en.html

ECB. (2012, February 29). *Open market operations*. Retrieved January 29, 2014, from http://www.ecb.europa.eu/mopo/implement/omo/html/20120034_all.en.html

ECB. (n.d.). *Statistics: Key ECB Interest Rates*. Retrieved March 18, 2013, from European Central Bank: http://www.ecb.int/stats/monetary/rates/html/index.en.html#fn5

ECB. (2003). The ECB's Monetary Policy Strategy. *Press Release* .

ECB. (2013, July). The Eurosystem Collateral Framework Throughout the Crisis. *Monthly Bulletin* , 71-86.

ECB. (2011). The Implementation of Monetary Policy in the Euro Area. *Official Journal of the European Union* , 16-18.

ECB2008a. (2008, March 28). *Press Release: Supplementary six-month longer-term refinancing operations and continuation of the supplementary three-month longer-term refinancing operations*. Retrieved June 4, 2013, from ECB: http://www.ecb.int/press/pr/date/2008/html/pr080328.en.html

ECB2008b. (2008, September 29). *Press Release: Conduct of a special term refinancing operation*. Retrieved June 4, 2013, from ECB: http://www.ecb.int/press/pr/date/2008/html/pr080929.en.html

ECB2008c. (2008, October 8). *Press Release: Changes in tender procedure and in the standing facilities corridor*. Retrieved June 6, 2013, from ECB: http://www.ecb.int/press/pr/date/2008/html/pr081008_2.en.html

ECB2008d. (2008, October 15). *Press Release: Measures to further expand the collateral framework and enhance the provision of liquidity*. Retrieved June 4, 2013, from ECB: http://www.ecb.int/press/pr/date/2008/html/pr081015.en.html

ECB2009a. (2009, May 7). *Press Release: Longer-term refinancing operations*. Retrieved June 4, 2013, from ECB: http://www.ecb.int/press/pr/date/2009/html/pr090507_2.en.html

ECB2009b. (2009, May 7). *Introductory Statement to the Press Conference*. Retrieved June 18, 2013, from http://www.ecb.int/press/pressconf/2009/html/is090507.en.html

ECB2009c. (2009, June 4). *Press Release: Purchase programme for covered bonds*. Retrieved October 6, 2013, from http://www.ecb.europa.eu/press/pr/date/2009/html/pr090604_1.en.html

ECB2010. (2010, May 10). *Press Release: ECB decides on measures to address severe tensions in financial markets.* Retrieved May 5, 2013, from European Central Bank: http://www.ecb.int/press/pr/date/2010/html/pr100510.en.html

ECB2011a. (2011, August 4). *Press Release: ECB announces details of refinancing operations with settlement in the period from 12 October 2011 to 17 January 2012*. Retrieved June 4, 2013, from ECB: http://www.ecb.int/press/pr/date/2011/html/pr110804_1.en.html

ECB2011b. (2011, August 7). *Press Release: Statement by the President of the ECB*. Retrieved October 14, 2013, from http://www.ecb.europa.eu/press/pr/date/2011/html/pr110807.en.html

ECB2011c. (2011, October 6). *Press Release: ECB announces details of refinancing operations from October 2011 to 10 July 2012*. Retrieved June 4, 2013, from ECB: http://www.ecb.int/press/pr/date/2011/html/pr111006_4.en.html

ECB2011d. (2011, November 3). *Press Release: ECB announces details of its new covered bond purchase programme (CBPP2)*. Retrieved October 6, 2013, from http://www.ecb.europa.eu/press/pr/date/2011/html/pr111103_1.en.html

ECB2011e. (2011, December 8). *Press Release: ECB announces measures to support bank lending and money market acitivity.* Retrieved May 5, 2013, from European Central Bank: http://www.ecb.int/press/pr/date/2011/html/pr111208_1.en.html

ECB2012a. (2012, March 8). *Introductory statement to the press conference*. Retrieved June 4, 2013, from ECB: https://www.ecb.int/press/pressconf/2012/html/is120308.en.html

ECB2012b. (2012, August 2). *Introductory Statement to the press conference*. Retrieved October 14, 2013, from https://www.ecb.europa.eu/press/pressconf/2012/html/is120802.en.html

ECB2012c. (2012, September 6). *Press Release: Technical features of Outright Monetary Transactions.* Retrieved May 5, 2013, from European Central Bank: http://www.ecb.int/press/pr/date/2012/html/pr120906_1.en.html

ECB2012d. (2012, September 6). Introductory Statement to the press conference. Retrieved December 3, 2013, from http://www.ecb.europa.eu/press/pressconf/2012/html/is120906.en.html

ECB2012e. (2012, October 4). *Press Release: Intorductory Statement to the Press Conference.*

ECB2012f. (2012, October 31). *Press Release: Ending of covered bond purchase programme 2 (CBPP2).* Retrieved October 6, 2013, from http://www.ecb.europa.eu/press/pr/date/2012/html/pr121031_1.en.html

ECB2013a. (2013, February 21). *Press Release: Details on securities holdings acquired under the Securities Markets Programme.* Retrieved May 5, 2013, from European Central Bank: http://www.ecb.int/press/pr/date/2013/html/pr130221_1.en.html

ECB2013b. (2013, July 4). Introductory Statement to the Press Conference.

ECB2013c. (2013, October 2). Introductory Statement to the Press Conference. Retrieved February 17, 2014, from http://www.ecb.europa.eu/press/pressconf/2013/html/is131002.en.html

ECB2014. (2014, February 6). Introductory Statement to the Press Conference. Retrieved February 17, 2014, from http://www.ecb.europa.eu/press/pressconf/2014/html/is140206.en.html

Eggertsson, G., & Woodford, M. (2003, June 26). The Zero Bound on Interest Rates and Optimal Monetary Policy. *Brookings Papers on Economic Activity* .

EU. (2012, October 26). Consolidated Version of the Treaty on the Functioning of the European Union. *Official Journal of the European Union* .

Evans, G. W., Guse, E., & Honkapohja, S. (2008). Liquidity traps, learning and stagnation. *European Economic Review , 52* (8), 1438-1463.

Federal Reserve Monetary Policy Statements. (2013, January 29). Retrieved May 5, 2013, from Federal Reserve: http://www.federalreserve.gov/monetarypolicy/files/FOMC_LongerRunGoals.pdf

Federal Reserve, B. o. (2007). Term Auction Facility FAQs. Retrieved from http://www.federalreserve.gov/monetarypolicy/files/TAFfaqs.pdf

Fischer, S. (1990). Rules Versus Discretion in Monetary Policy. In B. M. Friedman, & F. H. Hahn, *Handbook of Monetary Economics* (1 ed., Vol. 2, pp. 1151-1184).

Gürkaynak, R. S., Sack, B., & Swanson, E. T. (2005, May). Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking* .

Honkapohja, S., & Mitra, K. (2014). Targeting nominal GDP or prices: Guidance and expectation dynamics. *Bank of Finland Research Discussion Papers , 4*.

IMF. (2013, April 18). Unconventional monetary policies - Recent experience and prospects. *IMF Staff Paper* , p. 48.

IMF. (n.d.). *World Economic Outlook Database*. Retrieved February 11, 2014, from http://www.imf.org/external/pubs/ft/weo/2013/02/weodata/index.aspx

Joyce, M., Lasaosa, A., Stevens, I., & Tong, M. (2010, July). The Financial Market Impact of Quantitative Easing. *Bank of England Working Papers , 393*.

Joyce, M., Miles, D., Scott, A., & Vayanos, D. (2012). Quantitative Easing and Unconventional Monetary Policy - an Introduction. *The Economic Journal , 122*, 271-287.

Joyce, M., Tong, M., & Woods, R. (2011, Q3). The United Kingdom's Quantitative Easing Policy: Design, Operation and Impact. *Quarterly Bulletin* , pp. 200-212.

Klyuev, V., de Imus, P., & Srinivasan, K. (2009, November 4). Unconventional Choices for Unconventional Times: Credit and Quantitative Easing in Advanced Economies. *IMF Staff Position Note* .

Krugman, P. R., Dominquez, K. M., & Rogoff, K. (n.d.). It's Baaack: Japan's Slump and the Return of the Liquidity Trap. *Brookings Papers on Economic Activity , 1998* (2), pp. 137-205.

MacKinlay, C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature , 35*, 13-39.

Mishkin, F. S. (1996, February). The Channels of Monetary Transmission: The Lessons for Monetary Policy. *NBER Working Paper , 5464*.

Moessner, R., & Allen, W. A. (2013). Central bank swap line effectiveness during the euro area sovereign debt crisis. *Journal of International Money and Finance* .

Moessner, R., & Allen, W. (2012). International Liquidity provision and Currency-Specific Liquidity Shortages. *The Capco Institute Journal of Financial Transformation , 34*.

Obstfeld, M., Shambaugh, J., & Taylor, A. (2009). Financial Instability, Reserves, and Central Bank Swap Lines in the Panic of 2008. *American Economic Review: Papers and Proceedings , 99* (2), 480-486.

Papadia, F., & Välimäki, T. (2011). Functioning of the Eurosystem Framework Since 1999. In P. Mercier, & F. Papadia, *The Concrete Euro* (pp. 215-366). Oxford University Press.

Reuters. (2012, February 29). Banks gorge on 530 billion euros of ECB funds. Retrieved January 30, 2014, from http://www.reuters.com/article/2012/02/29/us-ecb-ltro-idUSTRE81S00R20120229

Reuters. (2011, December 21). Instant View: ECB allots 489 billion euros at 3-year tender. Retrieved January 30, 2014, from http://www.reuters.com/article/2011/12/21/us-ecb-tender-view-idUSTRE7BK0NO20111221

Reuters2013a. (2013, January 25). Banks repay 137 billion euros in crisis funds to ECB. Retrieved January 30, 2014, from http://uk.reuters.com/article/2013/01/25/uk-ecb-ltros-repayment-idUKBRE90O0G120130125

Reuters2013b. (2013, February 22). -Banks to repay ECB much less of crisis loans than expected. Retrieved January 30, 2014, from http://www.reuters.com/article/2013/02/22/ecb-banks-cash-idUSL6N0BM6D520130222

Rose, A. K., & Spiegel, M. M. (2012). Dollar illiquidity and central bank swap arrangements during the global financial crisis. *Journal of International Economics , 88*, 326-340.

Schmidt, R. H. (2001). Differences Between Financial Systems in European Countries: Consequences for EMU. In *The Transmission Process: Recent Developments and Lessons for Europe* (pp. 208-240). New York: Palgrave.

Shirakawa, M. (2002). One Year Under 'Quantitative Easing'. *Institute for Monetary and Economic Studies Bank of Japan Discussion Paper Series , E-3*.

Stone, M., Fujita, K., & Ishi, K. (2011). Should Unconventional Balance Sheet Policies be Added to the Central Bank Toolkit? A Review of the Experience So Far. *IMF Working Paper WP/11/145* .

Swanson, E. T. (2011, February). Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2. *Federal Reserve Bank of San Francisco* , 1-27.

Taylor, J. B., & Williams, J. (2009). A Black Swan in the Money Market. *American Economic Journal , 1*, 58-83.

The Federal Constitutional Court. (2014, February 7). Retrieved February 2, 2014, from Press Releases: https://www.bundesverfassungsgericht.de/en/press/bvg14-009en.html

The Federal Reserve's Response to the Financial Crisis and Actions to Foster Maximum Employment and Price Stability. (n.d.). Retrieved May 5, 2013, from http://www.federalreserve.gov/monetarypolicy/bst_crisisresponse.htm

The Lisbon Treaty. (n.d.). Retrieved February 22, 2014, from Article 125: http://www.lisbon-treaty.org/wcm/the-lisbon-treaty/treaty-on-the-functioning-of-the-european-union-and-comments/part-3-union-policies-and-internal-actions/title-viii-economic-and-monetary-policy/chapter-1-economic-policy/393-article-125.html

The Lisbon Treaty. (n.d.). Retrieved February 22, 2014, from Article 123: http://www.lisbon-treaty.org/wcm/the-lisbon-treaty/treaty-on-the-functioning-of-the-european-union-and-comments/part-3-union-policies-and-internal-actions/title-viii-economic-and-monetary-policy/chapter-1-economic-policy/391-article-123.html

Tobin, J. (1961). Money, Capital and Other stores of Value. *The American Economic Review , 51*, 26-37.

Trichet, J.-C. (2009, July 13). The ECB's Enhanced Credit Support. Munich, Germany: ECB.

Trichet, J.-C. (2012). Unconventional Monetary Policy Measures: Principles - Conditions - Raison d'etre. *Central Banking: Before, During and After the Crisis. 9*, pp. 229-249. International Journal of Central Banking.

Tuori, K., & Tuori, K. (2014). *The Eurozone Crisis: A Constitutional Analysis.* Cambridge University Press.

Ugai, H. (2007, March). Effects of the Quantitative Easing Policy: A Survey of Empirical Analyses. *Monetary and Economic Studies , 25*.

Välimäki, T. (2001, 8). Fixed rate tenders and the overnight money market equilibrium. *Bank of Finland Discussion Papers* .

Välimäki, T. (1998, April 27). The Overnight Rate of Interest under Averaged Reserve Requirements. *Bank of Finland Discussion Papers* .

Woodford, M. (2005). Central-Bank Communication and Policy Effectiveness.

Woodford, M. (2003). *Interest and Prices.* Woodstock, Oxfordshire: Princeton University Press.

WSJ. (2012, February 10). Draghi Urges Banks to Take ECB's Cheap Loans . Retrieved January 29, 2014, from http://online.wsj.com/news/articles/SB10001424052970203824904577212763546615878

www2.isda.org/newsroom. (n.d.). *International Swaps and Derivatives Association*. Retrieved February 9, 2014, from Press Releases: https://www2.isda.org/newsroom/press-releases/page/10